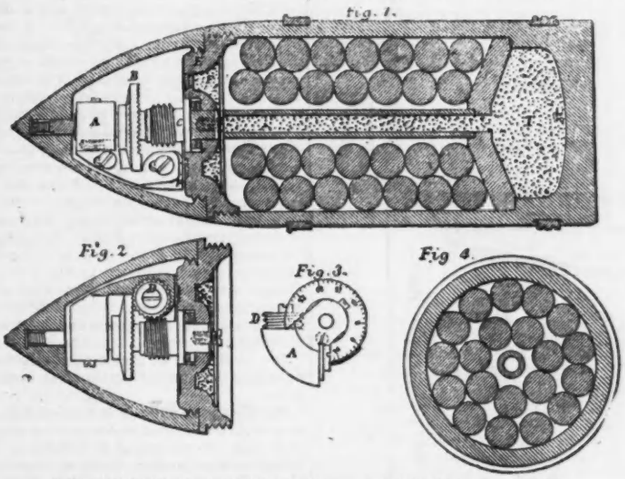
Berdan Shell and Fuze.

(*From an occasional Correspondent of Engineering*).
CONSTANTINOPLE, Oct. 17, 1884.

GENERAL BERDAN, the well-known inventor of several military appliances in addition to the rifle which bears his name, has lately been carrying out a series of trials at the Turkish artillery butts at Tchatalja, with a new form of shell fuze, for which he claims many advantages over those at present in use, both "time" and "percussion." The first-mentioned class of fuzes, depending for their action, as they do, upon the burning of a certain quantity of compressed powder within a given number of seconds, are subject to great inaccuracies, which much destroy the value of shell fire directed against troops, particularly when shrapnel is used. Fuze composition after a time changes its character, and the fuze may either burn too quickly or refuse to ignite, the result in the first case being a premature explosion, and in the second none at all. Again, how to get a fixed point for the attachment of any sort of machinery where all the parts are in motion, is an exceedingly difficult problem. This, however, is not the only difficulty the inventor has had to deal with. The velocity of a projectile gives a number of revolutions per minute, which renders it necessary to arrange some contrivance by which the latter may be reduced to the measuring capacity of a dial-plate of suitable dimensions for the size of shell. These two difficulties have been overcome, the one by the employment of an inertia weight, which maintains its position under all circumstances, serving as a bearing for the central axis as well as a point of attachment for the index arrangement, and the other by making the driving wheel of the latter a compound endless screw. The shell revolves according to the rifling of the gun, making one turn, as it may be, for every five yards of distance traversed, whilst the weight remains hanging vertically. The central axis or driving screw revolves with the shell, the



THE BERDAN SHELL AND MECHANICAL FUZE.

with percussion fuzes, the shock of contact does not always produce the desired effect, as there are several positions in which the shell may strike without setting the mechanism in action, as was so clearly shown in the recent bombardment of Alexandria. The "Berdan" system is aimed at remedying the defects of both these systems, so as to render it absolutely certain that a shell will explode at the exact point where its destructive effect upon the enemy would be the greatest. It is, properly speaking, a distance fuze, its construction being based upon the assumption that the revolutions of a rifled projectile in its flight, measures the distance traversed from its point of departure. It represents, in fact, the solution of a most difficult problem, the utilization of this rotary motion of a rifled shell, for the purpose of effecting its explosion at any required point in its trajectory. The idea has been worked out in a very ingenious manner, as a glance at the sectional views in this article will show. It is easy to understand that a projectile, preserving in its flight the motion given to it by the rifling of the gun, will cover a certain distance whilst making a certain number of turns. It is like a screw revolving upon its axis, and as with the propeller of a steamship, the number of revolutions made, shows the distance run, and this independent of the speed, or any alteration of it that may have taken place whilst the registration has been going on. The parallel, however, ends here, for whereas with the ship, the shaft and propeller may revolve at any amount of rate of speed, she herself will remain steady; in the case of the projectile, the whole is in motion. It is easy enough on board of a steam vessel to arrange for the shaft to register its revolutions, and to set other machinery in action when a certain number of revolutions have been made; but one end C being riveted into the diaphragm, separating the fuze compartment from the magazine, the other, as already explained, finding a bearing in the inertia block A. The driving wheel D, which gears into both the central axis and the index arrangement, as shown in Fig. 2, has twenty-five teeth, whilst the index is cut for fifty. The teeth of the driving wheel, which is of some thickness, have, moreover, a screw cut across them, and by this contrivance 1250 revolutions of the shell are reduced to one complete revolution of the index. In the present instance this would represent 6250 yards, and the dial-plate being graduated accordingly, each tooth moved forward would be equivalent to 125 yards of distance traversed. The firing is effected as follows: A pin presses against the hub of the dial, in which there is a slot cut. When the dial has moved round the distance for which it is set, this pin springs into the slot and is immediately pressed backwards. The other end of the firing pin is provided with a roughened surface, which, under the action above described, comes in contact with a ring of fulminate placed in the diaphragm, and the explosion of the shell naturally follows.

General Berdan has carried his intended improvement of shell firing even beyond the fuze. As seen in Fig. 1, he places the bursting charge of his shrapnel shell at the rear of the bullets, with the idea of its not becoming ignited until the head of the projectile has been blown off by the action of the fulminate, and the powder contained by the recessed ring at the back of the diaphragm. By this arrangement it is intended that the bullets should be blown out and scattered at the exact position before the enemy for doing the latter the most mischief. Referring to the diagrams, Fig. 1, shows a longitudinal section of the fuze and shell, Fig. 2 a section of the fuze showing the manner in which the index wheel D is geared, and Fig. 3 is the dial-plate with the inertia weight A attached; C is the central axis or driving shaft, E the diaphragm, S the fulminate ring, P the firing pin pressing upon it, F the powder ring of the diaphragm, and T the bursting charge of the shell. Theoretically this fuze is perfect. Placed in a lathe the mechanism works without the slightest hitch, the pin falling regularly for the distance set, and this whilst the fuze is revolving at a velocity far exceeding that which would be given to it on leaving a gun. Only private trials of this fuze have been made as yet—on the part of the inventor—with the view of testing the graduation of the dial-plates, although they have taken place in the presence of a few Turkish officers. From what I have been able to learn in respect to the recent proceedings at Tchatalja, the shells of which there were eighteen fired, all exploded at about the same distance from the gun, and the parts of one of the fuzes which were picked up, clearly showed that the firing pin had fallen into the slot as required. From this it would appear that General Berdan is on the road to success, although it will be necessary to prove by very exhaustive trials the accuracy of this system of fuzes under all circumstances, before the present methods of igniting the bursting charges of shell are abandoned in favor of it.

[Since the date of the above communication we learn that negotiations are being entered into by the British Government for purchasing from General Berdan the right to use his mechanical fuze, as well as some different types of torpedoes and range-finders.—ED. E.]

Determining the Thickness of Plates.

A method of determining the thickness of the iron plates in boilers or tanks, without cutting the plate, is described in *Le Génie Civil*. Although the process is rather rude as yet, the theory on which it rests is a most ingenious one, and the principle is capable of being applied to a very extended range of similar tests. M. Lebasteur, the engineer of the great French railway company Paris-Lyons-Mediterranean, deserves to have his name remembered as the inventor of the process, which in his hands has given results of singular accuracy. To test the thickness of a particular boiler-plate, or portion of a plate, M. Lebasteur spreads on the plate which he wishes to examine a spot of tallow, about one one-hundredth of an inch thick, and makes a similar application to a bit of sheet-iron of known thickness. He then applies to each, during a certain time, a small object, heated to a point as nearly constant as possible; using generally for the purpose one of the little cauterizing instruments made for surgical purposes. On the application of the hot instrument the tallow melts, forming a circle of bare metal around the heated point, bounded, after the place has cooled, by a little ring of tallow, raised above the surrounding portions. If the cautery has been applied for the same length of time to each plate, the diameters of the little melted circles upon the two plates will be to each other inversely as the thickness of the plates. The explanation of this of course is that in the thicker plate the heat of the cauterizing tool is conducted away so rapidly by the larger mass of metal that a small portion only is made hot enough to melt the tallow on it; while in the thin plate the heat is less freely diffused, and the effect extends laterally to a greater distance. Some variation in the results would probably come from the different chemical composition of plates tested, but it is worth noting that the direction of the fibres in the plates seems to have no influence whatever on the melting of the tallow.

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Sewage Purification at Frankfort-on-Main.

(Abstract prepared for ENGINEERING NEWS.)

BY WM. PAUL GERHARD, C. E.

Mr. W. H. Lindley, M. Inst. C. E., Chief Engineer of the Frankfort-on-Main Sewerage System, has lately published in the *Vierteljahrsschrift fur œffentliche Gesundheitspflege*, Vol. XVI, 1884, a detailed account of the proposed method of purifying the sewage of that city, from which we take the following description:

The purification works, as now being constructed, have largely been based upon, and the conception of the plan influenced by, certain local conditions, and in order to gain a clear understanding of the works it is well to know something about the conferences and discussions which preceded the planning and construction of the works.

A general plan for the sewerage of Frankfort-on-Main was adopted before the year 1866, at which time Frankfort-on-Main ceased to be a free city. This plan included the construction of two main sewer outlets, one on each side of the river Main, discharging into it at a great distance below the heart of the city, near the western city limits.

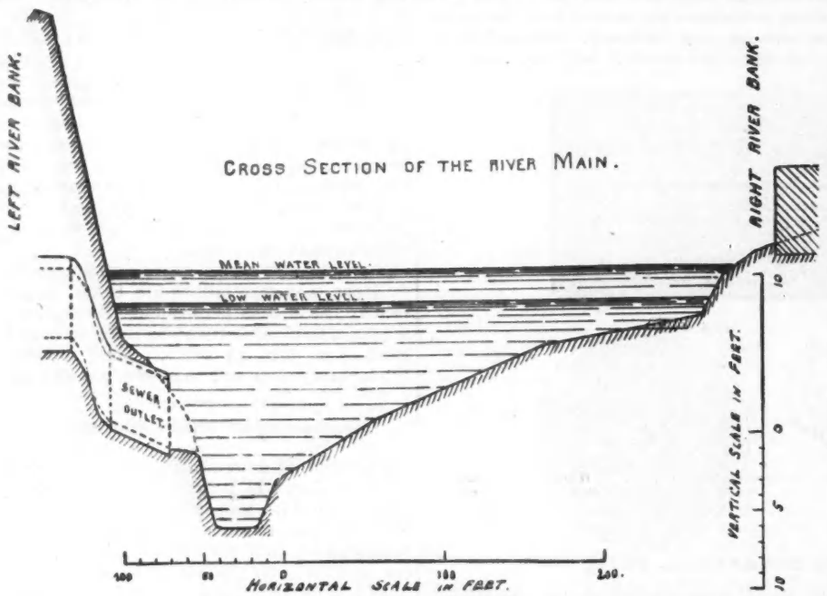


Fig. 1.

The sewer system was planned and constructed so as to allow, if necessary, the admission of the contents of water-closets, but it was not at first intended to make the sewers the receptacles and carriers of any solid excremental matters. The construction of the work was begun in 1867, the first aim being to relieve, with only a small expenditure of money, certain flooded city districts. It was, therefore, considered inexpedient to build the whole length of the two main intercepting sewers, and a temporary outfall near the gas works had to be constructed, serving that part of the city situated on the right-hand bank of the river Main. This outfall was afterward to be made a permanent storm overflow as soon as the two main outlets further down the river were built, but up to the present day it still forms the main outlet for the sewage of the city. With the growing extension of the sewer system a strong desire was manifested on the part of citizens and taxpayers to have the law repealed prohibiting the connection of water-closets to the sewers. The question was submitted to the judgment of Prof. von Pettenkofer as expert, who had up to that time opposed the introduction of fœcal matters into sewers. Contrary to expectation, Prof. von Pettenkofer declared himself in favor of admitting the contents of water-closets, after a careful survey of the existing conditions. After this decision, the sewerage system was rapidly extended over the remaining districts, and the number of house connections, in particular, increased very much, without even the necessity of having an ordinance making such a connection compulsory; in unsewered streets a loud demand for sewers arose, so that at the present day a very small district of the city only remains unsewered.

But this increased use of the sewer system caused, after a while, certain inconveniences and annoyances at the outlet, at which point, owing principally to the grades of the sewers being arranged so as to make them self-cleansing, excremental matter, paper, coarse solid floating matters, etc., arrived largely in an undissolved condition. The discharge of sewage was thus made perceptible at the outfall in a rather disagreeable manner, and the course of the sewage could be traced for quite a distance down the stream.

As early as 1873 and 1874 the municipal authorities took steps towards the completion of the main intercepting sewer and the construction of the permanent outlets, for at the locality selected for these, it would have been easy to construct works for the simple mechanical removal of all the above-named matters, in particular for the removal by means of strainers of the excrements, this being possible owing to the undissolved condition in which they arrived at the outfall. It would not have been practicable nor economical to locate such purification works at the temporary outfall near the gas works. The lower end of the intercepting sewer, however, could not be constructed owing to the opposition of the property owners, which led to discussions and transactions lasting several years. Meanwhile the nuisance at the temporary sewer outlet continued, the city authorities being unable to construct and put into operation the permanent works planned for the purification of the sewage. The Prussian Government, to whom numerous complaints had been sent by the people living in villages and towns situated below the sewer outfall, interfered in the latter's behalf, and ordered the city of Frankfort-on-Main to construct and arrange sewage irrigation fields. In consequence of this action the city was unable to receive the approval for the construction of the permanent outfall and to buy the property required by condemnation without which it was impossible to arrange for the proposed purification by mechanical means, of the city sewage. Mr. Lindley calls special attention to the fact that such a purification by means of strainers would have sufficed to remove the nuisance above described, caused by the discharge into the river of large quantities of coarse, solid and floating matter. The unusually large fall of the river between Frankfort and Mayence, and the consequent rapid current, together with the large volume of water discharged which would have caused a very great dilution of the sewage, would have sufficed, in his opinion, to render the discharge of the sewage unnoticeable.

Just at that time the introduction of another system of sewerage (probably the Liernur System) was strongly advocated and rendered the position of the city authorities more difficult, exerting not a little influence upon the transactions and resolutions passed. In order to comply with the demands of the Government, plans were prepared in 1876-77 for settling reservoirs and irrigation fields for the purification of the sewage of Frankfort-on-Main and of Sachsenhausen, and it was proposed to begin at once with the construction of the settling basins, which formed a part of the pumping-station, leaving the other works to be carried out later. The plans were discussed in all their details by the City Council, who then put the matter in the hands of a special commission, which visited a number of irrigation works in England and caused a thorough examination of the soil to be made with reference to the proposed scheme. At the request of the City Council the Government appointed special commissioners to investigate the actual conditions of the locality of the sewage outfall, which work enabled them to have a better understanding of the complaints filed, by having their attention called to the peculiar local conditions. This examination having been made, further reports and discussions took place without any immediate definite results.

A second inspection of the locality and further discussions in the years 1878-82 led to the adoption in October 1882 of the present plan for purification.

While the city authorities contemplated a *thorough mechanical purification* only by strainers and settling tanks, at the same time signifying their willingness to adopt further measures of relief, if such would be found to be necessary, the Government considered it absolutely necessary, before giving permission to discharge the sewage into the river Main, that a more efficient purification, by chemical precipitation, than could be attained by mere subsidence and mechanical clarification should be accomplished.

Such is, briefly stated, an outline of the facts which preceded the conception of the works, which we shall now describe, and which are at present in course of construction under the supervision of Mr. W. H. Lindley.

The requirement that chemicals should be added to the sewage, naturally had a great influence upon the selection of the locality of the purification works. If purification by mechanical means only had been adopted, it would have been possible to arrange separate works at both sides of the river for each of the intercepting sewers. But the addition of precipitating chemicals necessitated a joint arrangement of the settling basins for the sewage of Frankfort, as well as of Sachsenhausen, consequently it became necessary to cross the River Main by means of inverted siphons. In view of a future extension of the works or the possible required addition of other means for purification, it was deemed best to carry the sewage of Frankfort-on-Main across to the left bank of the river, and to locate the settling basins just below the new railroad bridge at Niederrad. This bank of the river offers larger level areas for possible future additions to the works. Other reasons for preferring this side were the number of inhabitants living below the sewage outfall. There are 6 villages and towns with a total population of 10,430 inhabitants, within a distance of 16 kilometers or about 10 miles from the originally proposed outfall on the right hand side of the river, while below the present location of the works on the left side of the Main are only 2 villages with a population of 3,500 within the distance mentioned. Among further reasons for preferring the left side may be mentioned that the discharge into the river occurs at a concave bend of the banks, consequently the main current passes very near to the point of outfall, and the sewage is at once largely diluted.

A cross section of the river, at the point where the outfall is located, is shown in Fig. 1, and distinctly indicates a rather curious deepening of the channel, measuring 4½ m. (nearly 15 feet) below the lowest water level, at a distance of only 25 m. (about 80 feet) from the river bank.

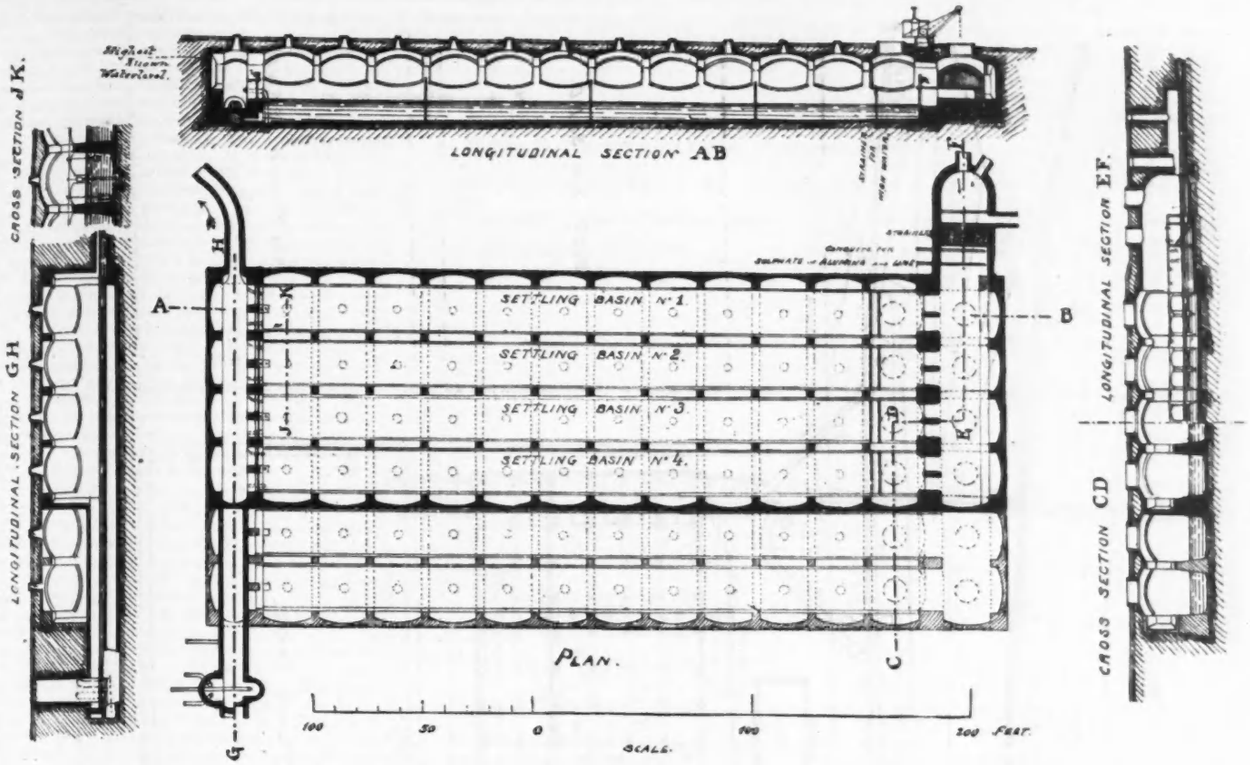
The high level of the locality selected renders any provision for protection against inundations unnecessary.

The sewage of the city is carried across the river by means of two inverted siphons, constructed of wrought-iron, each 0.75 m. (about 30 inches) in diameter, laid below the river bottom. Each of these siphons is capable of discharging 500 litres (132 gallons) per second, their combined capacity is therefore 1,000 litres (or 264 gallons) per second. In choosing these sizes due consideration was paid to a future increase of the population. At present *one* pipe would be sufficient to remove all the sewage, plus a like amount of rainwater, but, inasmuch as the total cost of the siphons depends not so much upon the price of the material as upon the cost of construction, it was thought advisable to lay both siphons at one time. A storm-overflow is provided at the right hand side of the river to remove any surplus water from heavy rainfalls, which the two siphons could not take care of. The capacity of the right hand side intercepting sewer is 2700 litres (714 gallons) per second, but it would have been useless to carry all this amount of comparatively pure water to the purification works, from where it would have passed at once into the river. Two siphons were preferred to one pipe of larger size, because the velocity of the flow in each was thereby much increased, thus making the siphon more self-cleansing. All the dry-weather flow passes through one inverted siphon, and the other is required only in case of rain storms.

Fig. 2 shows the general arrangement of the purification works, while Fig. 3 illustrates on a larger scale in plan, cross and longitudinal sections, the design for the settling basins. As stated before, the purification process is one of clarification by mechanical means, together with precipitation by chemicals. At first, those matters are removed which can be separated by merely mechanical means, in other words all floating substances, the grosser solids in suspension and the heavy impurities. Floating substances are intercepted by means of vertical plates or slabs, dipping into the water; matters in suspension are removed by strainers, and heavy matters are deposited by a retardation of the velocity of the current. Thus the action of chemicals is confined to those impurities which cannot be removed by any other cheaper process, and the sludge obtained is less mixed with sand and mineral débris, and its value as a fertilizer is consequently not so much reduced. It is proposed to use both sulphate of alumina and lime to effect a chemical precipitation.

Sulphate of alumina will be used as the principal chemical agent for precipitation and purification. Its action upon the sewage is due to a chemical combination of the acid with the alkaline substances in the sewage, by which the alumina is set free. The latter has a great affinity for fine organic matters and precipitates them in a flocculent form. Since the water does not contain sufficient alkalines to cause the whole amount of alumina to act, a sufficient quantity of milk of lime

FIG. 3.—PLAN AND SECTIONS OF SEWAGE SETTLING BASINS AT FRANKFORT-ON-MAIN.



is added to neutralize the mixture. The following advantages are claimed for sulphate of alumina against lime as a means for precipitation:

1. It acts not only upon matters in suspension, but also upon dissolved impurities.
2. The effluent water and the sludge are not of a strong putrefying character.
3. The amount of resulting sludge is less.
4. There is less danger of any free lime passing into the river.

It is proposed to use a kind of sulphate of alumina containing some iron, which latter not only accelerates precipitation but acts also as a disinfectant both of the effluent water and the resulting sludge.

The complete works comprise several settling tanks and a conduit leading to them, in which are arranged the catch pit for silt, the chamber for the screens and the mixing chamber; also a channel for the discharge of the effluent, with a conduit situated below it for the removal of the sludge; finally an engine-house, storage room for the lime and sulphate of alumina and rooms for grinding and preparing both precipitating solutions. All machinery required is located together in one building, and the whole works are arranged with a view of facilitating all working operations and avoiding as much as possible unnecessary transportation or shifting of any material.

Due consideration is given in the project to all possible future needs and requirements. At present the following works are being built: the main delivery conduits with storm overflows, the chamber for straining the sewage and mixing with it the chemical precipitating agents, four settling tanks, a discharge conduit, a conduit for the removal of sludge, the center wing of the engine house, with two engines of 15 horse power each and necessary boilers, pumps to protect the works in case of high water, a pump for emptying the basins, pump for the removal of sludge and possibly compressors and filter-presses; places for storage of sulphate of alumina and lime, rooms for grinding, and preparing the precipitants, and conduits from these to the mixing chamber; finally offices and quarters for the superintendent.

Besides the four settling tanks which are now being built, provision is made for two additional ones, which would form together one group, while a suitable location for a second group of six more settling basins, which may be required in the future has already been provided, as shown in the plans.

Much attention and thought was given to the important question at what height above the river the settling tanks should be located. If the water level in the tanks were to be kept above high water mark of the river it would have become necessary to lift the sewage constantly to a height of 5 or 6 met. (16.4—19.6 feet.) On the other hand the basins could be located below the level of the ground at a depth sufficient to allow the sewage to run by gravity into the tanks, and to have a free discharge into the river at least during the larger part of the year. Detailed investigations concerning this matter revealed no objection against the latter plan, and it was finally decided to construct the settling basins at such a depth that the sewage could flow into them without the necessity of pumping. The rigor of the climate would require (in Mr. Lindley's judgment) the covering of the reservoirs, even if they were located at a higher level, for he had found that even in the mild climate of England the formation of ice had rendered the operation of the settling tanks more difficult. Hence the only additional cost was that of excavation and of the masonry for the piers and retaining walls. This expense would largely be counterbalanced in the course of time, by the saving effected by avoiding the lifting of the water. Machinery is therefore required only for grinding and mixing the chemical ingredients, for emptying the basins, removing the sludge, and for lifting the effluent from the basins, in exceptional cases of very high water. All of these operations have to be performed at the lower end of the settling tanks, where the engine house and boilers are, consequently, located.

As shown on the plan, Fig. 2, the intercepting sewer from Sachsenhausen on the left bank of the river runs parallel to the stream, with a grade of 1 in 2,200, the dimensions being 1.14 met. (3' 9") width and 1.71 met. (5' 7") height. From this sewer a branch, 1 met. (3' 3") in diameter is carried to the northern end of the conduit leading to the settling tanks. A straight continuation of the intercepting sewer, 1.20 met. (about 4 ft.) in diameter serves as a storm-overflow, and runs parallel to the banks of the river to the main outlet of the works.

The two inverted siphons carrying the sewage of the City of Frankfort proper, are connected on the left bank of the river into one circular sewer, 1.20 met. (4 ft.) in diameter, which runs directly into the silt chamber. But before reaching this point, the sewer has another storm-overflow of 1.20 met. (4 ft.) diameter which connects with the first mentioned overflow, forming a sewer, 1.40 met. (about 4' 7") in diameter, which is carried with a fall of 1 in 100 to the outfall. These overflow sewers do not, usually, deliver any water, since the whole dry weather flow is discharged into the settling tanks.

The velocity of the sewage flow before reaching the silt chamber varies from 0.5-0.7 met. (1.63-2.25 feet) per second. At the entrance of the silt catch basin the velocity is suddenly reduced to only $\frac{1}{10}$ of the above amount, and the heaviest solids and silt are at once deposited by gravity. At the end of the catch basin a vertical slab is arranged, which dips about 0.40 met. (about 16 inches) into the water, reaching across the whole width of the conduit. This apparatus catches all floating matters, which are at once removed, and is arranged so it will act efficiently even at times of highwater.

Next follow the strainers or screens, which are placed in an inclined position in order to increase the amount of straining surface, and also to facilitate the removal of the strainers. There are 4 of the latter, each 1.45 met. or 4' 9" in width. A vertical plate may be tightly inserted in front of each strainer, when it becomes necessary to replace a strainer by a clean one.

The sewage from which the coarser and heavier substances have thus been removed enters the mixing chamber, where both the solutions of sulphate of alumina and milk of lime are added to and well mixed with it. It then enters the receiving conduit, from which it is alternately distributed by means of submerged weirs or sluices, into each of the four settling tanks, which run from east to west, parallel to the river. In the conduit as well as in the tanks subsidence takes place, the deposit in the former consisting mainly of fine sand, while in the tank a large portion of the finer suspended flocculent matters are deposited, owing principally to the addition of the chemical precipitants, and also to the velocity of flow being here reduced to a minimum. Each settling tank is 82.4 m. (270 ft.) long, and has a width of 6 m. (19.7 ft.) at the top and 5.4 m. (17.7 ft.) at the bottom. The bottom is slightly curved in the shape of an inverted arch, and has a total fall of 1 met. (3.28 ft.) from one end of the tank to the other. The depth of water in the basins amounts to 2 met. (6½ ft.) at the upper end, and 3 met. (9.8 ft.) at the lower end. The cross sectional area below the waterline amounts to 10.5 sq. met. (113.03 sq. ft.) at the upper end and 16.1 sq. met. (173.32 ft.) at the lower end, the average area being 13.3 sq. met. (143.17 sq. ft.) The contents of each basin amount to 1,100 cb. met. (290,600 U. S. gallons), and each section is calculated for the daily purification of 4—5,000 cbm. (1,057,000—1,321,000 gallons.) The average length of time during which the sewage remains in the settling basins is, therefore, six hours, the contents of the tank amounting to about 25 per cent. of the daily quantity delivered to each.

It is clear that the efficiency of subsidence must depend largely upon this proportion between the cubical contents of the basin and the daily quantity of sewage delivered. This percentage is, according to Mr. Lindley, 22½ per cent. at Leeds, 20 per cent. at Coventry, 26 per cent. at Aylesbury, 16 per cent. at Burnley, and only 5 per cent. at Bradford, where, however, an intermittent system is practised, which permits the sewage to come to absolute rest for several hours. In all the places named the tanks are left uncovered, while, as stated heretofore, the Frankfort settling tanks are to be arched over, thereby protecting them completely from the ill influence of winds, storms, and frost, thus adding to the efficiency of the precipitation system.

The four tanks which are now being built answer for the present daily dry weather flow of 18,000 cb. m. (4,755,000 gallons.) The average velocity of flow through the basins will be 4 mm. ($\frac{5}{32}$ inches) per second; this velocity decreasing from 5 mm. ($\frac{5}{32}$ inches) per second at the upper end to 3 mm. ($\frac{3}{32}$ inches) at the lower end of the tanks. It is expected that this change of velocity will have a tendency to separate the sediment, the heavier matters being deposited at the upper end, the finer substances at the lower end. The clarified sewage flows at the lower end over a weir into the remov-

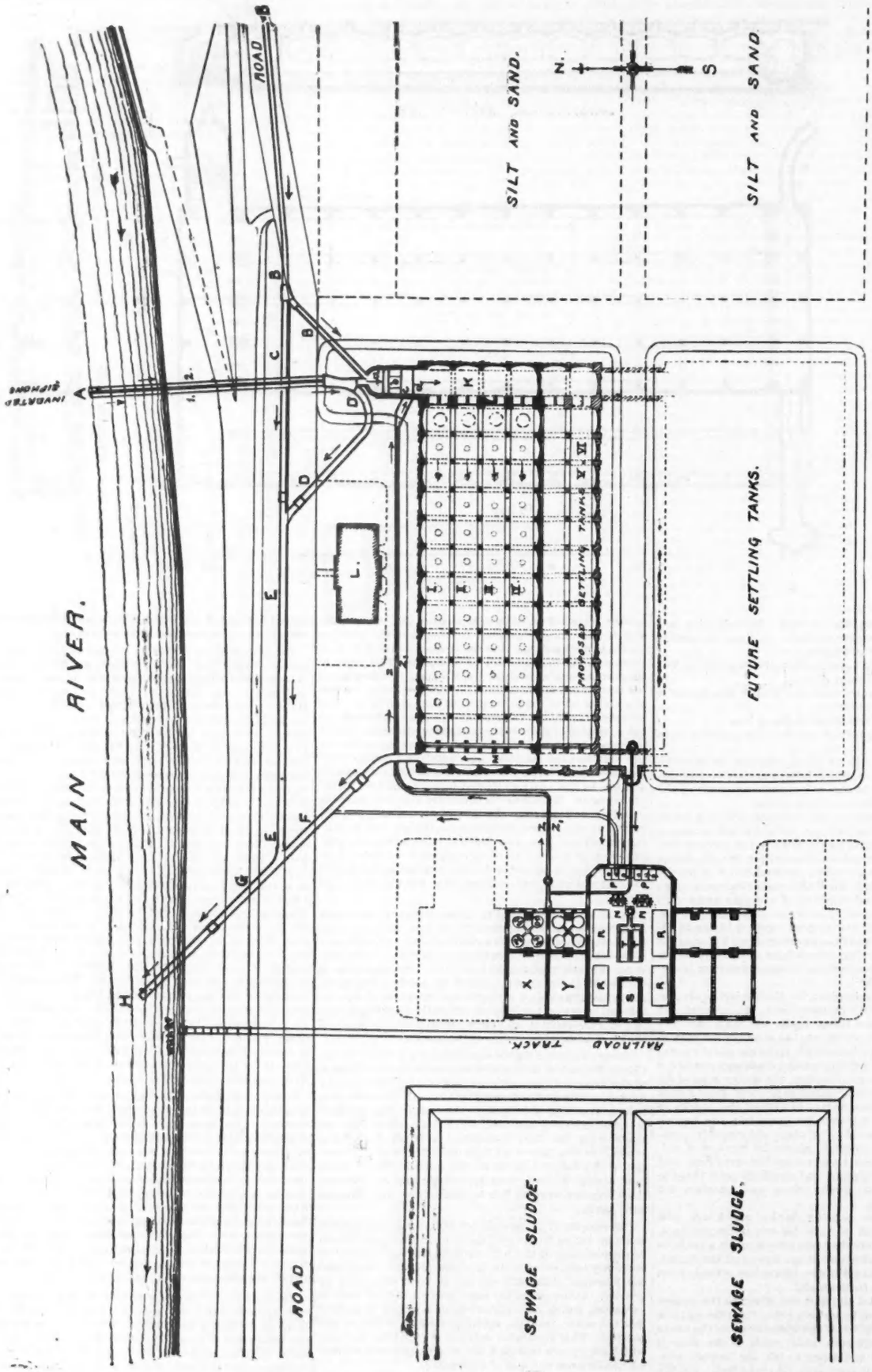


FIG. 2.—GENERAL PLAN, SHOWING LOCATION AND ARRANGEMENT OF SEWAGE PURIFICATION WORKS AT FRANKFORT-ON-MAIN.

ing conduit, which runs at right angles to the settling tanks, and has a width of 2 met. (9.8 ft.)

The tanks are emptied and cleaned as follows: The larger portion of the water in them is allowed to flow into the receiving conduit by opening a gate of 30 cm. (1 foot) diameter, placed at the end of each basin, which allows the removal of the water up to the level of the bottom of the receiving conduit. The remaining water must be removed by pumping. In order to do this, a second conduit of 2 m. (6 feet) width and 1.62 m. (5 feet in height, is built just below the removing conduit, and into it the water from the basin is emptied by opening successively, 3 gates placed vertically above each other, each 50 cm.(20") wide and 20 cm.(8") high, beginning with the uppermost gate. This is done in order to prevent the current from stirring up and sweeping with it the deposit at the bottom of the tanks, which would occur if there was only one gate-valve in place of three.

This conduit delivers the water to a sump, from which it is removed by a centrifugal pump, and discharged, as long as it appears to be clarified, into a conduit and carried under pressure to the main outfall. But as soon as turbidity appears, the water is diverted into a manhole on the line of the conduit, which carries the solution of chemical ingredients into the delivering conduit at the eastern end of the works, whereto it is again returned to be once more purified.

The centrifugal pump has a discharging capacity of 100 litres per second (26.4 gallons) and hence empties each tank, the water in which has previously partially been withdrawn as described, in two hours, or else the full contents of one basin in three hours. The water being thus removed, the further cleaning consists in removing the sand and solid deposits by pails. A movable steam-crane, placed on a truck, running on a track parallel to the upper delivering conduit, lifts the pails through openings in the arches built over the tanks, and the contents of the pails are delivered to wagons and driven to places of deposit. The liquid sludge which cannot be removed by pails, is drawn out by a pump having a 20 cm. (8 inch) suction pipe, which together with the necessary valves, is kept in an accessible position. It is expected that each basin will have to be cleaned once every week.

The clarified sewage is carried by a circular sewer of 1.40 cm. (about 4½ feet) diameter to the outfall into the river. The outfall delivers, as shown in profile, Fig. 1, much below the lowest level of water in the river, the conduit being a wooden tube, built of staves somewhat similar to the manner in which barrels are made.

The outfall is provided with a gate valve to protect the settling tanks against backflow in case of high water, but the tanks continue, in such a case, to receive the sewage, which is pumped out by pumps provided for this purpose, and the delivering conduit from these pumps discharges into the outfall sewer below the gate valve, as shown in plan. Special screens are to be provided which are to be placed across the entrance to all settling tanks and are to act in case of very high water, which, however, is not expected to occur oftener than once in three years.

All arches covering the tanks and conduits are provided with light shafts or manholes, which answer at the same time for ventilation and for the removal of sand. All settling basins are being constructed in the most substantial manner with concrete and masonry laid in Portland cement.

Touching the removal of the sludge, similar results are expected as have occured in England. The sludge, as removed from the settling tanks, contains about 90 per cent. of water and its manurial value is consequently such that it is not worth transportation. It would cost too much to artificially remove this water, consequently the sludge is stored or spread upon large surfaces of land.

Mr. Lindley asserts that at Leeds, Bradford, Coventry, Birmingham and Aylesbury he found such large masses of sludge spread on wide surfaces to be entirely without odor, notwithstanding the fact that his visit occurred during the hot month of August. At Leeds he found an accumulation of 20,000 cb.m. (26,160 cb. yds.) of sludge, and could only detect a faint odor, not at all offensive, in close proximity to it. The same he found to be the case at Birmingham, where the sludge covered about 100 hectares (247 acres) of land without emitting noisome odors.

The plan shows two storage places, located west of the engine house, capable of holding about 5,000 cb. m. (6,540 cb. yds.) of sludge. These places of storage are underdrained by common land drains, which will effect a partial removal of the water, while the balance of the water will be lost by evaporation. The sludge gradually becomes solid enough to be removed in cars. As soon as a market is found for the sludge, it is proposed to hasten the removal of the moisture in the sludge by means of filtering presses or suitable compressors. Mr. Lindley thinks that, owing to the easy manner of loading the sludge into vessels, due to the location of the works, and owing to the cheapness of transportation by water, a demand may soon be created for manure on the neighboring farmlands.

Provision is made for storing 200 tons of sulphate of alumina and 100 tons of lime. The former is broken in small pieces and then thrown into four reservoirs lined with lead, and filled with water, to be dissolved with the aid of a suitable mixing apparatus. The lime is slacked and mixed in four mills. Each solution is delivered by means of a pipe conduit, 0.25 m. (10 inches) in diameter, having a fall of 1:100 towards the mixing chamber at the upper end of the settling tanks.

Fig. 2. General Plan, Showing Location and Arrangement of Sewage Purification Works at Frankfort-on-Main.

A—Inverted siphons of wrought-iron, each 30 inches in diameter.
B—Main intercepting sewer for Sachsenhausen.
C—Storm-water overflow, No. 1.
D—Storm-water overflow, No. 2.
E—Combined storm-water overflow.
F—Conduit for effluent sewage.
G—Outfall sewer.
H—Main outlet.
I—Gate-valve to shut off sewer against high water.
K—Receiving Conduit.
L—Headquarters of Superintendent.
M—Delivering Conduit.
NN—Engines.
PP—Pumps.
RR—Filter Presses.
S—Coal.
X—Storage room for lime.
Y—Storage room for sulphate of alumina.
ZZ₁—Two pipe conduits for the chemical precipitating solutions.
a—Silt catchpit.
b—Screen chamber.
c—Mixing chamber.

Specifications For Coated Cast-Iron Water Pipes and Special Castings, Boston Water Works.

SPECIFICATIONS.

(1.) The work to be done consists in furnishing the following Pipes and Special Castings:

——tons of——inch pipe, Class, etc.,——tons of special castings, more or less, as may be required in connection with the above pipes, consisting of Branches, Bends, Reducers, Bevel Hubs, Curved Pipes, Sleeves, and all or any other Special Castings directed by the Engineer in this connection, subject to all the conditions and requirements of this Contract and Specifications.

The amounts in tons of the various diameters and classes of pipes above called for are to be considered as approximate only. The Engineer shall have the right of increasing or diminishing the amounts called for by this contract in any way, and for any reason, which he may deem necessary, provided such increase or diminution does not exceed twenty per cent. of the total amount of the contract.

(2.) All pipes and other castings shall be delivered.

(3.) Every pipe and special casting shall have cast upon it the initials of the maker's name, and the year in which it was cast; and every pipe shall have cast upon it the running number of the casting of the same size, and the class letter. The letters and figures to be cast on the outside, not less than two inches in length, and one-eighth of an inch in relief.

(4.) The Contractor shall also provide, at his own expense, at the foundry where the castings are made, proper sealed scales and weights for weighing the pipes and special castings; which weighing shall be done at the expense of the Contractor, under the supervision of the Engineer, and the weight of each pipe or special casting shall be conspicuously painted in white on the outside or inside before delivery. Care shall be taken to have the painting done after the coating becomes hard.

(5.) The pipes shall be made with hub and spigot joints, which shall accurately conform in shape and dimensions to the drawings furnished.

(6.) They shall be true circles in section, with the inner and outer surfaces concentric.

(7.) The straight pipes shall be straight, and the curved pipes shall be true to the required curvature in the direction of their axes.

(8.) They shall be of the specified dimensions in internal diameter from end to end, and the straight pipe shall be twelve feet in length, exclusive of socket.

(9.) Especial care shall be taken to have the sockets of the required size. The sockets and spigots will be tested by circular gauges, and no pipe will be received which is defective in joint-room from any cause. The joint-room for each class of pipe is shown in the table marked "Joint-room, Weight," etc.

(10.) All special castings shall be made according to such drawings and instructions as will be given by the Engineer from time to time.

(11.) The weight of the straight pipe shall closely average as follows:

Diameter of Pipe.	Thickness of Joint for Calking.	Length of Pipe, Twelve Feet, Exclusive of Socket.		
		Class A—Weight.	Class B—Weight	Class C—Weight

(12.) The length of pipe shall not be changed except by written permission of the Engineer, and, in case of such change, the weight of the pipe, given in Sect. 11, shall be modified proportionately.

(13.) No pipe will be received the weight of which shall be less than the above-specified weight by more than—— per cent. for the——inch pipes, or more than 4 per cent. for the 24-inch pipes and under, and no excess of weight above the specified weight, of more than the percentage given above for the different sizes, will be paid for.

(14.) The metal shall be made without any admixture of cinder iron, or other inferior metal, and shall be remelted in the cupola or air-furnace. It shall be of such character as to make a pipe strong, tough, and of even grain, that will satisfactorily admit of drilling and cutting, and shall possess a tensile strength of at least 16,000 lbs. square inch.

(15.) Specimen rods of the metal used, of a size and form suitable for a testing-machine, shall be prepared for the Engineer when required.

(16.) These specimen rods shall be poured from the ladle at any time, either before or after the pipe has been poured, as may be required, and shall present a true specimen of the iron used for making the pipes.

(17.) The straight pipe shall be cast in dry-sand moulds, in a vertical position, with the hub-end down, and the curved pipes in loam.

(18.) The flasks of all pipes shall be allowed to remain in position a sufficient length of time to prevent unequal contraction.

(19.) The pipes and special castings shall be free from scabs and defects of every nature; no plugging or filling will be allowed; they shall be thoroughly cleaned, and no lumps or rough places shall be left in the barrels or sockets.

(20.) All pipes and special castings, of whatever form shall pass a careful hammer inspection, and after having been cleaned under the direction and to the satisfaction of the Engineer, shall be carefully coated inside and out with coal-pitch varnish, according to Dr. Angus Smith's process.

(21.) The surfaces must be entirely free from rust, and no casting shall be coated unless examined and approved by the Engineer immediately before the process begins, as to the cleaning and condition of the surfaces. The Contractor shall provide a covered tramway from the casting-room to the dipping-vat, so that no casting shall be liable to become wet previous to its being coated.

(22.) The coating shall be applied under the following conditions:—

(23.) The coal-pitch varnish used must be of a character to make a smooth coating, tough and tenacious when cold, and not brittle, nor with any tendency to scale off.

(24.) Each casting shall be heated to a temperature of 300 degrees Fahrenheit, immediately before it is dipped, and shall possess not less than this temperature at the time it is put in the bath. Each casting shall remain in the bath at least thirty minutes.

(25.) The pitch shall be heated to a temperature of 300 degrees Fahrenheit (or less if the Engineer shall so order,) and shall be maintained at this temperature during the time the casting is immersed.

(26.) Fresh pitch and linseed oil shall be frequently added to keep the mixture at the proper consistency, and the vessel shall be occasionally emptied of its contents, and refilled with fresh pitch.

(27.) Any pipe or special casting that is to be recoated shall first be thoroughly scraped and cleaned.

(28.) After being coated, the pipes shall be carefully drained of the surplus pitch, and, when dry, shall be subjected to a proof, by water pressure, of——lbs. to the square inch, and, if required by the Engineer, they shall be subjected to a careful hammer test, under this pressure. They shall be subjected to proof by water pressure, etc., after their delivery and before their final acceptance, if required by the Engineer.

(29.) All tools, materials, and men necessary for the proper test and inspection of the castings shall be furnished by and at the expense of the Contractor.

(30.) The castings will be weighed for payment, after the application of the coal-pitch coating, and, if so desired by the Engineer, they shall be weighed after their delivery, and the weights so ascertained shall be used in the final settlement of this contract.

(31.) The Engineer shall be at liberty at all times to inspect the material in the foundry, and the moulding, casting, and coating there. The forms, sizes, uniformity, and conditions of all pipes and other castings herein referred to shall be subject to his inspection and approval, and he may reject, without proving, any casting which is not in conformity with the specifications of drawings furnished. He shall have power to prevent the use of any metal, mould, or core which in his opinion may not be proper for the purpose for which it is intended.

(a.) The application of the coal-pitch shall be made to his satisfaction, and the material shall at all times be subject to his examinations and rejection.

(b.) He shall have the right to make alterations in plan, form, or dimensions of the Special Castings herein mentioned.

(32.) All the pipes and other castings contracted for must be delivered in all respects sound and conform

able to the contract. The inspection will not relieve the Contractor of any of his obligations in this respect; and any defective pipe or other casting, which may have passed the inspector at the works, or elsewhere, will be at all times liable to rejection when discovered, until the final adjustment and completion of the contract. Care must be taken in handling the pipes not to injure the coating, and no pipes or other material of any kind shall be placed in the pipes during transportation or at any time after they receive the pitch coating.

(33.) The delivery of the pipes shall commence——and shall be continued with regularity till the——day of ——18 , when the contract shall be completed. Special Castings to be delivered as may be required by the Engineer. The rate of delivery of the different sizes shall be varied as required by the Engineer.

(34.) The ton used shall be the gross ton of twenty-two hundred and forty pounds (2,240 lbs.).

(35.) All the work contemplated and described in this contract and specifications shall be done to the satisfaction of the Engineer, who shall be sole judge as to the fitness of materials, and shall have the right of correcting any errors or omissions in the contract and specifications when such corection is necessary for the proper fulfilment of their intention; the action of such correction to date from the time that the Engineer gives due notice thereof in writing.

(36.) Wherever the word "Engineer" is used herein, it shall be understood to refer to the City Engineer of the City of Boston and to his properly authorized agents, limited by the particular duties intrusted to them.

(37.) Wherever the word "Contractor" is used herein, it shall be understood to refer to the party or parties of the second part to this agreement.

D. On condition of the true and faithful performance of this agreement and these specifications, the said party of the first part agrees to pay to the said part of the second part at the rate of——for all——inch pipe, Class——per ton gross, of 2,240 lbs., and at the rate of ——dollars per ton gross, 2,240 lbs. for the Special Castings; all of said Pipes and Special Castings to be coated by Dr. Angus Smith's patent process; said coating to be perfected at the foundry and in accordance with the terms of the specifications herein named, and the prices per ton above mentioned to include the coating of said Pipes and Special Casting, and all the labor and expenses attending the proving at the foundry of said Pipes and Special Castings, except the per diem of the Inspector, to be met and paid by said part of the second part. If the completion of the contract is delayed beyond the specified time, the expense of inspection caused by such delay shall be deducted from any amount which may be due the Contractor, unless otherwise decided by the Engineer.

E. Payments to be made monthly on the weight of said castings received in proper order and condition, according to the certificate of the Engineer, reserving ten per cent. until the completion of this contract to the satisfaction of said City Engineer. *Provided*, that nothing herein contained be construed to affect the right, hereby reserved, of the said Boston Water Board to reject the whole or any portion of the aforesaid Pipes and Special Castings, should the said certificate be found or known to be inconsistent with the terms of this agreement, or otherwise improperly given.

F. In order that the conditions of this contract, as regards the continuous delivery, may not be misunderstood, it is hereby agreed that this contract may, at the option of the said party of the first part, be declared and considered forfeited if, on or before the——day of ——next, there should not have been delivered in good condition, in terms of these specifications, at least——of the Pipes, and at least——of the Special Castings herein contracted for; or if there should not have been delivered in like terms during each succeeding month, until the time of the completion of this contract,——of the Pipes and——of the Special Castings herein contracted for.

G And the said party of the second part further agree that——will execute a bond in such sum and with such securities as shall be approved by the Boston Water Board, for the faithful performance of this contract, conditioned to indemnify and save harmless the said city and the said Water Board, or any member thereof, from all suits and claims of every name and description, brought against the city of Boston, or said Water Board, or any member thereof, for or on account of any injuries or damages received or sustained by any person or persons, by or from said part of the second part, ——servants or agents, in the fulfilment of this contract, or by or on account of any act or omission of the said party of the second part, or——agents, or by reason of any failure by the party of the second part to deliver the castings in the manner and at the time hereinbefore agreed upon, and for the faithful performance of this contract by the party of the second part; and the said party of the second part hereby further agree that so much of the money due to——under and by virtue of this agreement, as shall be considered necessary by the Boston Water Board, may be retained by the said party of the first part, until all such suits and claims for damages as aforesaid shall have been settled, and evidence to that effect furnished to the satisfaction of said Water Board.

H. If, under the process of inspection, there shall have been rejected, under the conditions of this contract and specifications, during any twenty days continuously of its limitation, twenty-five per cent. of the Pipes and Special Castings offered within that time for acceptance, the contract may, at the option of the said party of the first part, be declared forfeited, and it shall be forfeited accordingly.

I. And it is agreed that this contract shall be in writing and executed in triplicate, one of which triplicate shall be kept by the said Boston Water Board, one to be delivered to the City Auditor of said Boston, and one to the Contractor, that this contract or any part thereof, or any sum due or to come due thereunder, shall not be assigned or transferred without the written consent of said Water Board, and shall at the election of said Water Board be utterly void as to the said city, if any person appointed to any office or employed by virtue of any ordinance of said city, or of any Act of the Legislature relating to the supplying of water to said city, or any matter or thing connected therewith, is either directly or indirectly interested therein.

J. The said party of the second part further agree, that if the work to be done under this agreement shall be abandoned, or if this contract shall be assigned by the party of the second part, otherwise than as herein specified, or if the conditions as to rate of progress are not fulfilled, or if at any time the Engineer shall be of opinion, and shall so certify in writing to the Water Board, that said party of the second part violating any of the conditions or covenants of this contract or fulfilling said contract in bad faith, the said Water Board may notify the aforesaid party of the second part, and the contract and agreement shall then, at the election of said Water Board, become null and void; and thereupon the said party of the second part shall cease to continue said work, and said Water Board shall thereupon have the right to procure of other parties all or any part of the work left uncompleted by the said party of the second part, and the said party of the second part shall be liable in any damages caused the said City of Boston by reason of said party of the second part not completing this agreement.

K. All Pipes and Special Castings, of whatsoever description, upon which advances may have been made, shall become thereby, so far as acceptable in other respects, the exclusive property of the said party of the first part; and whatever may be found, after delivery, objectionable in castings upon which advances may have been made, the said party of the second part shall make good and replace immediately on receiving notice thereof; and if said defective or objectionable castings are not replaced within thirty days after the delivery of said notice to the said party of the second part at their office or place of business, the said Boston Water Board, as agent of the party of the first part, may then obtain from other parties, at their discretion, the castings rejected in the terms of this agreement, and the cost and expense of replacing such rejected castings by sound and unobjectionable ones shall be paid by the said party of the second part, or deducted from any balance due or which may become due to the said party of the second part by the said party of the first part.

L. It is hereby understood that, with the exception of such instructions and corrections as the Engineer, under the provisions of this contract, is entitled to make, the terms and conditions of this contract, or any one of them, cannot be dispensed with or rendered in any sense null and void without the written consent of the said party of the first part attached to or indorsed on this agreement, specifying what modifications may have been agreed upon.

M. This is to bind the representatives of the parties respectively.

In Witness Whereof, The parties to these presents have hereunto set their hand and seal, the day and year first above written.

Slag Cement.

We have on various occasions referred to the ingenious and very successful processes of Mr Frederick Ransome, for the manufacture of cement from blast furnace slag and lime. The discovery, made about twelve years since by Mr. Charles Wood, that slag run from the blast furnace in a melted condition falls into a fine granulated state, removed one of the main objections to its utilization the great cost attending its reduction to powder by mechanical means. One of the materials composing the Ransome cement is thus obtained ready for use, and being practically a waste product, its cost is nominal, the expense attending its application being limited to handling. By his earlier method the other material employed—chalk or lime—was ground and mixed with the slag, the combination being then calcined, and again ground; from this resulted a cement possessing very high qualities both as regards quickness in setting, and strength. Very recently, however, Mr. Ransome, following the same line of investigation, has improved greatly on his former simple process, and he has found that the spent lime from gas works may be employed with results as good as those obtained with lime prepared specially for the purpose. In order, however, to get rid of the sulphur with which the lime is saturated when it leaves the gas purifier, Mr. Ransome resorts to a very simple and efficacious device. He mixes a certain proportion of powdered coal or coke with the slag and lime, and when this is exposed to the heat of the calcining furnace, the action of the coal or coke converts the sulphide into a sulphide of lime, that is subsequently entirely got rid of by the introduction of a jet of steam which drives off the whole of the sulphur impurities as sulphuretted hydrogen, leaving the lime quite pure. This, however, is only one of the recent improvements to which we have referred. A highly important modification is the use of a revolving retort for the calcination of the slag and lime. It is found that after the materials have been thoroughly burnt in this manner, they remain in the same fine state of subdivision as when they were placed in the retort, and on being discharged will pass through a sieve of 80 meshes to the inch. The costly process of grinding, which is unavoidable in the ordinary method of manufacture, is thus avoided, while the cement is said to lose none of its useful characteristics in this novel process. Of course this system is equally applicable where fresh lime is employed, instead of the waste material from gas works, only in such a case it is unnecessary to add the powdered coke, or to apply the steam jet. We have referred in general terms to the strength of the cement produced by this method; the following Table of comparative tests made with samples of Portland and Ransome cement show clearly the remarkable qualities possessed by the the latter; the samples in each case were 1½ inch square, giving a sectional area of 2¼ square inch.

Age of Sample	Portland Cement. Breaking Load.	Ransome Cement. Breaking Load.
	lb	lb.
2 days	510	740
3 "	698	870
7 "	818	1170
12 "	...	1300
15 "	...	1330
21 "	...	1440
28 "	936	
7 years	1327	

The foregoing figures speak for themselves, and indicate clearly that the Ransome cement possesses striking advantages over Portland, especially as it reaches a strength within a few days, which is higher than the Portland after seven years. Very important advantages are also found in the simplicity of manufacture, and the suppression of the final process of the cement manufacturer, that of grinding. The plant used is therefore simpler and involves much less expense in maintenance and labor for the production of a given quantity of cement than is required in the ordinary mode of manufacture. When in addition to this, it is remembered that materials are employed, it will be easily understood why the slag cement can be made for half the cost of Portland, and the commercial importance of Mr. Ransome's process will be readily appreciated.—London. *Engineering.*

EAU CLAIRE, WIS., Feb. 12.—Now that the common council has granted a franchise to build water-works to Fairbanks, Morse & Co., nothing remains but to secure legislation necessary to empower the city to take this step and legalize the action of the council, which has not this power under the charter. The water-works will be in operation before December 1 next.

Index to Periodical Literature.

In response to numerous inquiries for a reference index to current periodical literature, we herewith open a new department in ENGINEERING NEWS. To successfully carry it forward involves procuring, by purchase or exchange, a large list of journals, and the labor of examination and collation. Our list as yet, is very incomplete, but as we progress, by our own experience and the suggestions of readers we hope to make this index a valuable feature of our journal. It will be printed only on one side of the paper so as to allow cutting out if desired.

Arch. Stability of *Le Tracé des Courbes de Pression das les Voutes.* An elaborate, analytical study of the curves of pressure, by M. Lavoinne. *Annales des Ponts et Chaussés*, October 1884.

Blasting. *"Water Blasting."* Method of applying, when it can be employed, and advantages. *Engineering News*, January 31, 1885, p. 67.

Bore Hole. *Finding a Bore Hole*, by means of magnetic needles. *Engineering*, also *Engineering News*, January 31, 1885, p. 69.

Brake, Westinghouse. *Application du Frein Westinghouse.* A history of its use on the Chemin de Fer a l'Ouert, with a long list of accidents which have been avoided by its use. *Le Genie Civil*, December 27, 1884 pp. 140 to 142.

Bridge, Atchafalaya. *Pont de Chemin de fer sur le fleuve Atchafalaya.* A description of the bridge built on Morgan's Louisiana & Texas R.R. The details of the pile foundations are clearly and fully shown on a plate of engravings. *Annales des Ponts et Chausses*, December 1884, p. 1243.

Bridge, Blaauw-Krautz. *"Viaduct of Blaauw-Krautz, Cape Colony, Africa."* Description, with 7 illustrations of a very original and curious construction with method of calculation. From *Le Genie Civil* December 6, 1884, Trans. in *Engineering News* January 24, 1885, pp. 50 and 51.

Bridge, Dneiper *Bridge over the Dneiper (Russia).* Plan elevation, cross-sections and details of one span (2648 4"). The section shows a railway *through* the bridge, and a roadway on the *upper* chord. *Engineering*, January 24, 1883, pp. 85 and 88.

Bridge, Forth *Le Pont sur le Golfe de Forth.* The present status of the work, with detailed accounts of the work done on the foundations and superstructures. Illustrated with general views, and sketches of the details of the work. *Le Genie Civil*, December 27, 1884, pp. 133 to 136.

Bridge Foundations. *See* **Foundations. Bridge.**

Bridge, Hoogly *Bridge over the Hoogly, East Indian R.R.* Plans, elevations and details of main girders 420 feet span. *Engineer*, January 23, 1885, p. 62. Described in *Engineer*, January 2, 1885, p. 7.

Bridge, Lauterman Falls, O. *Bridge at Lauterman Falls near Youngstown, O.* An interesting example of a hinged arch of 175 feet span. General view and details. *American Engineer*, January 2, 1885, pp. 4 and 5.

Bridge, N. Y. and Brooklyn. Diagrams showing the amount of travel and traffic for each hour of a given day. The amounts for foot passengers, car passengers and wagons of all kinds are given separately. *Engineering News*, January 31, 1885, p. 74.

Bridge, N. Y. and Brooklyn. *N. Y. and Brooklyn, Bridge Data.* For foundations, towers, superstructures, cable railway, etc., *Engineering News*, January 31, 1885.

Bridge, Robert Street, St. Paul, Minn. *"Bids received January* 19, 1885 for the construction of the abutments and piers of the proposed iron bridge over the Mississippi at St. Paul, Minn., at Robert Street." Detailed table. *Engineering News*, January 31, 1885, p. 79.

Bridge, Rollers. *Strength of Solid Metallic Rollers to Resist Crushing.* A criticism of existing formulæ and the submission of a new formula, for which greater accuracy is claimed. By J. B. Johnson Mem. Eng'r Club of St. Louis. *Journal of the Association of Engineering Societies*, January, 1885, pp. 110 to 114.

Canal, Suez. *The Maritime Canal of Suez, from its inauguration, 1869 to 1884.* The most complete history and description of this canal yet published. Illustrated with many maps, plans, drawings of appliances etc. Prepared under orders of the Bureau of Navigation, Navy Dept., by Prof. J. E. Nourse, U. S. N. *48th Cong. 1st, Sess. Senate. Ex. Doc.* 196 1884.

Concrete, *Cost of.* A statement of the manner of making concrete at the Hiland Ave. Reservoir of the Pittsburgh New Water-works, giving the materials used (American Hydraulic Cement, mixed 1, 2 and 5) and the cost in place. Emile Low. *Engineering News*, January 24, 1885, pp. 51 and 52.

Ditch Improvements, *Just apportionment of the Cost of: a problem.* Discussion of an important Ohio question. Read before the Society of Ohio Engineers and Surveyors, January 14, 1885, by E. B. Opdyke. *Engineering News*, January 24, 1885, pp. 53 to 55.

Dredge. *"Atlas" Dredge.* A floating dredge removes the material from the attached cutter by means of suction pipe, and delivers it at a distance through pipes floating on surface. In use in Oakland harbor. Several illustrations. *Engineering News*, January 31, 1885, pp. 68 and 69.

Dredge, *Bruce and Bathos Dredge.* Illustrated description of self-propelling dredge used in British Burmah. Operated by hydraulic power. Bucket composed of 3 segmental scoops. *Engineering*, also *Engineering News*, January 24, 1885, p. 52.

Earth Pressure. *See* **Retaining Walls.**

Electric Lighting *in Belfast.* A description of the method of lighting Harland & Wolf's ship yard (covering 48 acres) with arc and incandescent lamps, with general plan of yards and illustrations of Newton's arc lamp. *Engineering*, January 23, 1885, p. 72.

Engine, Fireless. *The Honigmann and Fireless Engine.* In this engine the steam is generated by a solution of hydrate of soda-NoOHO. An account of experimental trials, and of its actual use in locomotives, in Germany, with the advantages over ordinary engines, is given in this article. Illustrations of the locomotives are also given. *The Engineer*, January 23, 1885, pp. 60 and 61.

Foundations, Bridge. *See also under* **Bridge.**

Foundations, Bridge; Havre de Grace, Md., B. & O R. R. *The Caissons, Cribs and Cofferdam of the B. & O. Bridge, Havre de Grace, Md.* The foundations consist of a caisson, surmounted by a crib, and that again by a cofferdam, all these parts being united in one. A detailed description, fully illustrated. By Wm. M. Patton, *Engineering News*, February, 7, 1885, pp. 83 to 85.

Foundations, Lighthouse. *St, George's Reef, California.* Detailed account of the difficulties encountered in preparing the foundations on an isolated reef. By Capt. A. H. Payson. *Ann. Report of the Lighthouse Board*, 1884. Appendix 1.

Fuel. *Consumption of Coal on Railways.* Tables giving the consumption of coal per train mile, on various English R. R. with the data from which the results are obtained, and an analytical study of the results. *The Engineer.* January, 23, 1885, pp. 59 and 60.

House building *in Buenos Ayres.* General arrangement of building, and materials used. *Engineering News*, January, 31, 1885, p. 66.

Hydraulic Machinery. *See* **Machinery, Hydraulic.**

Lighthouse Foundations. *See* **Foundations, Lighthouse.**

Machinery, Hydraulic. *Boston Docks (Eng) Hydraulic Machinery.* Illustrations of hydraulic pumping engines, boiler, and accumulator house. *Engineer*, January, 23, 1885, pp. 63 and 66.

Maps, Relief. *Methods of making Relief Maps.* Mace Moulton, *Engineering News*, January, 31, 1885, p. 75.

Maps, Relievo; *Manufacture of.* Description of an ingenious method. *Building News* also *Engineering News*, January, 24, 1885, p. 55.

Mississippi River. *See* **River Floods.**

Municipal Service Examination. Examination Papers for applicants for positions of Rodman, Draughtsman and Topographical Engineer. *Engineering News*, January 24, 1885, p. 49.

Navy. *The United States Navy.* A review of the annual report of Secretary Chandler on the condition and wants of the navy, and of the recommendations of the Advisory Boards. *Engineering*, January 23, 1885, pp. 89 and 90.

Paving. *"Minneapolis Street Paving."* Bids received for granite and for cedar pavements. Detailed table. *Engineering News*, January 31, 1885, p. 79.

Pressure of Earth. *See* **Retaining Walls.**

Rails. *Creeping of Rails.* Method of prevention successfully used on the Savannah, Florida & Western R. R. H. W. Reed. *Engineering News*, January 31, 1885.

Railroads. *See also* **Rails, Tracks.**

Railroads *in New South Wales.* Particulars regarding the principal lines in course of construction; giving costs, etc. *Engineering*, January 23, 1885, pp. 75 and 76.

Railroad Management. *Notes on Railway Management.* A statement of some of the evils in the present management; their causes and remedies. By Wm. K. Ackerman. *North American Review.* December 1884, pp. 521 to 546.

Railroad, Ship. *See Ship Railway.*

Tennessee Weather Report for January.

Carefully Compiled Statistics Gathered from Thirty-seven Stations in Tennessee.

The following is a summary of the weather report for the month of January, compiled by Maj. H. C. Bate, of the Bureau of Agriculture, Statistics and Mines:

Mean temperature, 33 58.
Highest temperature, 69, on the 16th, at Grief.
Lowest temperature, 5° below zero, on the 22d, at Riddleton.
Range of temperature, 74.
Mean monthly range of temperature, 58.77.
Greatest monthly range of temperature, 69, at Riddleton.
Least monthly range of temperature, 48, at Barren Plains.
Mean daily range of temperature, 13.
Greatest daily range of temperature, 43, on the 16th, at Nashville.
Least daily range of temperature, 1, on the 6th, at Bolivar, and on the 24th, at McKenzie and Trenton.
Mean of maximum temperatures, 62.23.
Mean of minimum temperatures, 03.26.
Mean depth of rainfall, 6.96 inches.
Mean daily rainfall, 0.224 inch.
Greatest rainfall, 10.08 inches, at Careyville.
Least rainfall, 3.30 inches, at Greeneville.
Greatest local daily rainfall, 4.70 inches on the 14th, at Fostoria.
Days of greatest rainfall, 5th, 6th, 11th, 14th, 15th, 16th, 23d and 24th.
Day of greatest rainfall during the month, 15th.
Average number of days on which rain or snow fell, 10.8.
Average number of clear days, 7.
Average number of fair days, 8.
Average number of cloudy days, 16.
Average snowfall during the month, 0.42 inches.
Prevailing direction of wind, north and northwest.

SELECTED MISCELLANY.

THE platinum mines of the Ural Mountains, in Russia, now supply the world with that metal. It is shipped first to dealers in France and England, where it brings about $28 per pound of pure metal. It is necessary to refine it carefully; in the crude state it consists, according to a recent analysis, of 75.1 of platinum, 1.1 palladium, 3.5 rhodium, 2.6 iridium, .6 osmiridium, 2.3 osmium, .4 gold, 1 copper, and 8.1 iron.

VALUABLE deposits of manganese are said to have been discovered near Batesville, Ark. The manganese was first discovered on a tract of 1,200 acres of land entered at $1.25 per acre, before the discovery. The manganese belt, or district, is estimated to be about twelve miles long. The ore occurs in pockets, and is an "oxide running from 40 to 65 per cent. of matallic manganese."

A PRIMITIVE BAROMETER.—The barometer used by the remnant of the Araucanian race, inhabiting the southern province of Chili, consists of the cast-off shell of a crab, which is said to be extremely sensitive to atmospheric changes, remaining quite white in fair, dry weather, but indicating the approach of a moist atmosphere by the approach of small red spots, which grow both in number and size as the moisture in the air increases, until finally, with the actual occurrence of rain, the shell becomes entirely red and remains so throughout the rainy season.

COST OF PUBLIC BUILDINGS.—A communication to Congress from the treasury department gives in detail the number and cost of the public buildings erected by that department. One feature is interesting, that showing what limit Congress placed upon them compared with the sum that the department spent upon them under the idea that the limit set by Congress was of no account. Thus the following table gives some idea how little attention was paid by the supervising architect to the law:

	Limit.	Actual Cost.
Bangor	$ 50,000	$ 269,878
Portland	300,000	545,900
Rockland	50,000	144,828
Boston Post Office	1,500,000	5,841,516
Fall River	200,000	492,953
Hartford	400,000	846,998
New Haven	88,000	189,770
Portsmouth	88,000	165,674

Of the New England States, Maine had $2,078,008.

THE HEAVIEST RAIL.—The New York Central is now using the heaviest rail in this country on the section of its line from the Grand Central Depot to Mott Haven Junction, where the Harlem line leaves the Hudson River line. This portion of the line is about five miles long, chiefly in the tunnels, or on the viaducts of what is known as the "Fourth avenue improvement." It has an enormous passenger traffic, including that of the New York Central, the Harlem and the New York, New Haven and Hartford, but not much freight traffic, as the New York Central freight enters and leaves the city by the old Hudson River line. The rail used here weighs eighty pounds per yard.

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A PERSONAL investigation into the late alarming explosions in Pittsburgh, Pa., resulting from the recent introduction of natural gas, develops the fact that there is not so much mystery after all in these demonstrations as some would have us suppose. A sifting of the evidence seems to prove that economy in pipe-laying, and the greedy and unwise haste of the rival companies to first supply the demand for the new fuel, lies at the bottom of the trouble.

We understand that the pipe-trenches, in many cases at least, were roughly excavated under incompetent direction, and at some points the pipe is laid within two feet of the surface; that lengths of many hundred feet were screwed together alongside the ditch, and then tumbled in without reference to proper alignment and gradients. Under conditions such as these there is little wonder that leakage should occur, and the escaping gas accumulate in sewers or cellars until other conditions should arise to bring about an explosion.

The pipe generally used is wrought-iron with screw-joints, and it is in these joints that the trouble occurs; no pipe has yet burst from gas-pressure according to our information. Bad pipe-jointing and careless pipe-laying seem to be responsible for all the damage so far done.

In regard to the leakage of this subtle natural gas through cast-iron pipes and fittings, we could gather little authenticated data. A single case was reported, where a cast-iron fitting, that had been tested to 700 pounds per square inch, hydraulic pressure, did leak gas under 100 pounds gas-pressure. The gas is said to have apparently exuded from the pores of the iron and could be lighted by a match anywhere on the outer surface of the fitting. We give this rumor as we heard it, but would be happy to hear the result of careful experiment in the direction of fairly investigating the action of this new product upon cast and wrought-iron. It is an important question both to those who supply and those who consume, or are in any way brought into contact with, natural gas.

The Chief of the Bureau of Yards and Docks

The approaching retirement from active service of Rear Admiral Nichols, the present Chief of the Bureau of Yards and Docks of the Navy Department, will create a vacancy in that office and suggests the urgent need of the exercise of some civil service reform in the appointment to be made on March 1st.

This Bureau has in its charge the design, construction, repair and maintenance of the naval dry-docks, the buildings and all public work connected with them; it is purely technical in the detail of its operations, and has civil engineers for its administrative officers. The impropriety and incongruity of appointing a line officer of the navy, whose theory and practice in nowise fit him for the exercise of his duties, as the executive head of this department, is apparent. Yet, for no other reason apparently than because "it always has been so," the chief is selected from that branch of the service.

The other seven Bureaus of the Navy Department have each a chief properly selected from the corps whose affairs it controls; the staff is in charge of those appertaining to the staff, and the line officers direct the departments of ordnance, navigation and equipment. This general good policy being recognized in the seven Bureaus, why, in the name of common sense, will not the same rule hold good in the eighth Bureau, which is really a Bureau of Civil Engineering?

In all other civilized nations the controlling spirit in the corresponding department is an expert civil engineer, an official fitted by study and experience to direct engineering operations and to control the movements and pass judgement upon the plans of civil engineers. England has in late years recognized the profession by appointing a Civil Engineer as a Civil Lord in its Board of Admiralty. We alone among nations adhere to a method which is on a par with our out-of-date ships and inefficient guns.

It is time that we made a change in accordance with the demands of public policy and common justice, and now is the proper time to inaugurate this reform. The appointing power need not go abroad in seeking a fitting head for this department; the officers of the Civil Engineers of the Navy have within their own ranks men well fitted for the office, and the senior officer of that staff corps is eligible by law for appointment to the position. The engineers alone of all the staff and line corps in the Navy, are without a professional head, or even a representative in the Navy Department; they are, under the old system, subordinate to an officer who is professedly ignorant of all the technical details of the office, a man who is literally of no practical use and who can only hamper the movements of his administrative officers and interfere with the public good by his ignorance of professional duties or by his traditional prejudice to the staff.

The engineer officers now make the plans and estimates and recommendations upon which millions of money are expended. And as they *must* be intrusted with the real duties of the department, why is it insisted upon that they should have a figure-head for a chief? The reform is inevitable in the near future and it would be a creditable and graceful act in the present administration to make the much needed new departure in the forthcoming appointment.

The St. Johns Dry Dock, Newfoundland.

The following description of the Simpson Improved Dry Dock, constructed for H. B. M. Colonial Government at St. Johns, Newfoundland, is condensed from the official report of P. C. Asserson and F. C. Prindle, Civil Engineers U. S. N., to the Secretary of the Navy, under date of Dec. 18, 1884.

The dock was constructed by J. E. Simpson & Co., and is built on what is known as the American system of timber dry docks. The general dimensions are as follows:

Greatest length on coping, head to outer gate sill	610 ft.	10 in.
Greatest length on floor, head to outer gate sill	569 "	6 "
Greatest width of body on coping	132 "	6 "
Greatest width of body on floor	49 "	10 "
Least width of entrance, inner abutment on coping	84 "	9 "
Least width of entrance, inner abutment on floor	52 "	9 "

The greatest beam of floating gate or caisson is 20 feet 6 inches making the total available length of dock on axis inside of gate at outer abutment, on coping, 601 feet 6 inches, and on floor on top of 2 feet keel blocking, 563 feet. The greatest depth of water over inner gate sill, high water, spring-tide, is 25 feet.

This dock is located at Riverhead, in the harbor of St. Johns, and is similar in shape and construction to the wooden graving docks in Brooklyn, Philadelphia and Baltimore.

It is built upon spruce pile foundation, except the floor, which rests upon a bed of Portland cement concrete, varying from 2½ inches in thickness at the head to about 6 feet at the entrance. The concrete floor foundation itself rests upon a glacial deposit of compacted slaty gravel immediately overlying the bed rock. The substratum is not water-bearing, as none appeared in the 2-inch tubes inserted in the concrete foundation.

Longitudinal yellow pine timbers 12 by 12 inches, spaced about 3 feet apart, are imbedded in the concrete floor and anchored to it by iron bolts and bars; four of these timbers laid close and secured together are placed under the keel-way. Upon these longitudinal timbers are fitted and secured heavy transverse floor timbers 14 by 16 inches yellow pine, spaced 4 feet centers and covered with 3 inch spruce planking, to form the working floor. Keel blocks are secured to each of these floor timbers and the usual sliding bilge blocks are fitted to every fourth timber, or 16 feet centers on each side of the dock. Small open drains are formed in the concrete on each side of the keel way, under the floor timbers and lead to the pump well; the space between the floor timber is also filled with concrete at the outer ends, sloping towards the drains.

The sides and head of the dock are built on a slope of about 54° outward from the vertical; the altars being of yellow pine timbers 8 inches and 11 inches tread. These altars are fitted and bolted to inclined heavy brace timbers of yellow pine, supported by six rows of piles and abutments on the floor timbers at the lower ends. At their upper ends the braces are secured to a system of cross-caps, 2 feet beneath the surface, of 12 by 12 inches yellow pine, extending back about 30 feet from the coping and supported by six rows of piles to which the caps are firmly secured. Diagonal timbers are also introduced to tie the two systems of braces, cross-caps and piles together. The altars are carefully filled in behind with selected material, well rammed, as they are built up. Around the entire dock and immediately outside the outer row of piles supporting the cross-cap timbers, a line of 5 inch tongued

and grooved spruce sheet piling is driven to exclude tide water.

The dock has two gate sills and abutments, the sides having an outward slope of about 30°. The sides and floors are strongly built of solid yellow pine timber, in two thicknesses, laid to break joints, the joints of each being carefully wedged with pine wedges. The floor is laid upon, and secured to, transverse timbers imbedded in the concrete, and the sides are secured to heavy brace timbers supported by piling and filled behind with concrete. The sills are oak, and their faces are secured by rubber gaskets, making the gate joint watertight.

The apron extends 20 feet beyond the outer abutment, and is constructed of timbers on a concrete foundation as inside. It is also covered with concrete extending 13 feet outward to form a toe beyond the basin. Cross-lines of sheet piling, on each side of the dock, connect with the lines before mentioned; one line at the end of the apron, two at the outer abutment, two at the inner abutment and one at the inner end of the inner abutment.

The dock is closed by an iron floating gate or caisson, made with straight sloping sides, corresponding to the angle of the abutments, and a straight keel which bears against the sill and solid timbers of either abutment at pleasure; the outer sill being one foot below the inner sill, no groove is necessary. The greatest beam of the caisson is 20 feet 6 inches, and the width of keel and stems is 2 feet. It has a flush upper deck and is fitted witn 8 filling sluices each 22 inches in diameter, controlled by suitable valves operated from between decks inside. On the caisson is a 6-inch centrifugal ballast pump, engine, boiler and steam capstan.

The dock is emptied by two 30-inch Allen centrifugal pumps, each driven by horizontal engine having 21 inch diameter of piston and 22-inches stroke; the maximum engine speed is 170 revolutions per minute with 80 pounds of steam. The suction pipes to the pumps are 36-inches diameter and the pump center is 19½ feet above the dock sill. In addition, the dock is provided with a 10-inch Heald and Sisco centrifugal pump to remove leakage water, which is about 1000 gallons per minute, owing to high level defects in the sheet piling, which are being remedied. The guaranteed capacity of the main pumps is 6,400,000. Imperial gallons in 2½ hours, with the speed before given.

Work was commenced on the dock May 28, 1883; on Dec. 24, work was suspended until April 24, 1884; the entrance work was completed on Nov. 28, and water admitted to the dock the next day; the dock was first pumped out on Dec. 2, 1884. The first vessel, H. M. S. "Tenedos," was successfully docked on Dec. 10. This is the largest graving dock in America and it will take any merchant vessel afloat except the "Great Eastern."

The Manufacture of Liquid Gunpowder.

One of the greatest difficulties encountered in the manufacture of gunpowder, lies in the intimate mixture of the different ingredients the combustion of which produces the explosion.

Mr. Nordenfelt has just taken out letters patent for an ingenious and probably new idea in this connection. In place of grinding together the chief ingredients of sulphur, charcoal and saltpetre, in a solid state, he proceeds as follows: The sulphur, in the desired proportion, is dissolved in a sulphuret of carbon, then the carbonaceous matter is mixed with it; this later material is not wood charcoal, as in the older formulæ, but is cotton or any cellulose fibre which can be reduced to the state of an inpalpable powder. Finally, there is added to this mixture a saturated solution of saltpetre in proper proportions.

It is then only necessary to permit the liquid portion to evaporate, to obtain a powder in which, according to the declaration of the inventor, all the elements are most intimately mixed and capable of furnishing the maximum explosive effect.—[*Le Genie Civil.*]

The "Combined System," as applied in the Sewerage of Washington, D. C.

As an advocate for the introduction of the combined method of sewering cities, whereever this method can properly be applied, I notice with regret the possible injury due to sound sanitation by the operation of the Government Engineers at Washington, D. C., under the name of the "combined" system of sewering.

It should be borne in mind that the advocates of the "separate" method are by no means silenced, and the main argument in support of their method, viz., "reduced expense," is one that appeals to our tax-payers with a force that cannot be ignored. This argument fails of application, however, where the "separate" method is carried out in its entirety, that is to say, separate channels for the conveyance of house sewage and storm or surface water; but the advocates of the separate method, in order to economize in first cost, ignore, at times, the necessity of *drainage*, and confine their efforts to the removal of house sewage simply, leaving the surface water to take care of itself, and point triumphantly to various localities where this method has been attended with no present mischief—notably Memphis, Tenn.

It is needless to go into the arguments in favor of either method, as it is a long story, upon which much ink may, as heretofore, be uselessly wasted; but to come to the point I would emphasize, it is clearly the duty of the sanitarian, if the combined method has the merits which we claim for it, not to hamper this method of sewering with a greater load of expense than is absolutely necessary, in order not to furnish our opponents with a means of attack wherewith to demolish our outworks.

In the report of the sewer department of the District of Columbia for the last year, it is stated that "the system under construction is entirely what is known as the 'combined' system—*i. e.*, the sewage and rainfall are carried off in the same channel;" and further, that the sizes of the sewers are computed of a capacity sufficient to carry off a rainfall of two inches per hour, *all in the time of its fall.* The report goes on to state "that this is very much in excess of the computations which have been usually adopted in other cities, where the maximum rainfall has generally been taken at *one* inch per hour, and one-half of this estimated as reaching the sewers, and the other half being absorbed by the ground or evaporation, etc." We do not so understand the practice of other cities.

Nearly thirty years since, an engineer was called upon to project the drainage and sewerage system adaptable to the city of Brooklyn, and found cause to justify the opinion that even on built up and paved surfaces, and irrespective of any loss from absorption or evaporation, no rainstorm on large areas, of two inches to the hour, or even of one inch to the hour *could*, on the usual grades in our city streets, *run off in the time of its fall.* And from the comparative infrequency of storms in that locality, exceeding one inch per hour, in a report of that date, he recommended the adoption of that limit as to rainfall to be provided for, while the capacity of the sewers need be but one-half of this, as no more than that proportion of the rainfall could reach the outlet of the sewers in that length of time. This report, it is believed, was the source from whence the limit of rainfall and capacity of sewers for surface water was derived throughout the country, and continues pretty generally to this date to be the accepted proportions, certainly on the coast, and to the eastward of the Alleghany range.

Many circumstances of locality, it is needless to say, may be expected to modify the amount of *annual* rainfall; this is of but little consequence however, as it is the volume of the individual storms which taxes the capacity of the sewers, and not the number of storms in the year. Permit me to quote from the report alluded to, for the benefit of would-be associates of the "combined" method, as worthy of their careful consideration.

"With reference to the amount of rain-fall to be provided for. No system of sewerage yet proposed in any city, contemplates the removal of *excessive* storm-waters by means of the sewers alone. Such storms, for instance, as discharge for short intervals two or three inches of rain in the hour. They occur at long intervals, and are of short duration, and the damage is usually confined to limited areas, whilst the construction of sewers to meet the contingency, would be attended with an enormous expense over the whole city, both in construction and repair, and of doubtful efficiency when suddenly called upon, and extremely objectionable as conduits for the ordinary flow of sewage."

In Mr. J. H. Shedd's report upon the sewers of Providence for 1874, it appears that for the forty years preceding, in that locality, of 324 storms recorded, 229 were not in excess of ¼ inch *to the hour*, while but 9 of the storms exceeded *one* inch in the hour, and but three of the nine, equally 2 inches in the hour.

In the table of dimensions and capacity of sewers under construction in Washington City, designed to carry off 2 inches of rain in an hour, my attention was called to a sewer outfall of 22 feet in diameter, with the table given, capable of discharging some 6,000 cubic feet per second.

What this amount of water means, will be more apparent, if we refer it to some examples of the same discharge elsewhere.

The summer flow of the Hudson River at Troy gauges at but 2,000 cubic feet per second.

The flow of the Delaware River at Trenton is about the same, as is the summer flow of the Merrimac at Lowell. At the latter place, the power of the river is estimated at 4,200 cubic feet per second with pentage. We may infer then, that this sewer is designed to carry a volume of water exceeding the summer flow of these rivers. Can it be possible that this sewer will ever be called upon to discharge such a volume of water in so short a time? And if not, why is it built of such dimensions?

It is to be presumed that the effluents are designed on an equally liberal scale, this being a specimen brick, and the city once known as "the city of magnificent distances," may hence be characterized as the city of magnificent sewers!

We do not object to the government *experimenting* in this direction; it will prove in the end, *capitol* practice; but would it not be as well to call it by its right name, as an experiment, and not send it before the country as the essential of a properly devised "combined" method, a system of sewerage, as a standard for great cities? The resources of a Nation might pay for such projects, but few cities could hope to do so. J. W. A.

MAYOR O'BRIEN, of Boston, has appointed a committee of well-known physicians to act as advisors of the Board of Health in taking measures to prevent the spreading of cholera if it should visit Boston during the coming summer. The committee consists of Henry J. Bigelow, Henry S. Bowditch, Richard M. Hodges, Francis M. Minot, Charles M. Folsom, William L. Richardson, George B. Shattuck, John G. Blake, and Samuel A. Green.

ENGINEERING NEWS Three Months for One Dollar.

Growth of Travel in New York.

The wonderful growth of the passenger traffic of New York City in the last thirty odd years is an interesting study, and the following figures are deduced from a table published by the New York Arcade Railway Co.:—

In 1850 there were only two railway lines in the city and the total number of passengers carried was less than 7,000,000; in 1884, the total of passenger traffic for all railways and omnibus lines were 302,183,362. This is an average increase of over 9,000,000 per year. In 1850 the population of the city was 515,547; while in 1880 it was 1,206,299. Taken by decades, the increase of travel has reached 141 per cent., and the growth in population only 46 per cent.

The elevated railways carry nearly one-third of the moving mass, or in 1884, 96,702,620; but as the natural growth of passenger travel between 1877 and 1884 was over 120,000,000, or more than 23,000,000 above the presented capacity of the elevated lines, it would seem that the rapid transit problem is yet to be solved. The more railways there are the more they seem to be used, and the statistics prove that increased facilities invariably bring about an increased ratio of travel. In 1855, four railways carried, each, over 4,500,000 passengers; in 1865, twelve roads carried nearly 7,000,000 each; in 1875, nineteen roads nearly 9,000,000 each, and in 1884, twenty-three lines transported over 12,350,000 passengers each.

The publication referred to, basing its figures upon the semi-decade 1875-80, showing the lowest percentage of increase in travel, viz.: 15 of population and 27 of traffic, estimates that, in 1890, an increase in passenger traffic of 138,000,000 will have to be provided for; and in 1900, or fifteen years from now, the increased demand will reach the enormous figures of 561,000,000.

If these deductions are even approximately correct it is very evident that the facilities for travel in the city of New York must be vastly extended to meet the possible demand of the next few years. There appears to be room for nearly, if not quite all, of the various transit projects afloat, both elevated and underground, cable roads and ordinary tramways.

PERSONAL.

W. B. PARSONS, Roadmaster of the Susquehanna Division of the Erie R. R., has had his territory increased by the addition of the Tioga R. R. and its leased lines, 65 miles of additional track.

MEMPHIS, Tenn., Feb. 13.—Yesterday morning, W. R. HARVEY, a civil engineer, interested with J. S. McTighe in constructing levees in Coahoma County, Miss., 15 miles south of Friar's Point, shot and killed ED. MANEY, a foreman of one of the several gangs of men engaged in building the levees. The general opinion is that HARVEY was justifiable in his actions.—*Nashville American.*

R. B. CABLE has been reappointed Superintendent of the Susquehanna Division of the New York, Lake Erie and Western R. R. MR. CABLE resigned this same position about 18 months ago to become General Superintendent of the Denver & Rio Grande R. R., and later filled the same position on the North Pacific R. R. The Tioga R. R. and its leased lines, 65 miles in all, have been added to the Susquehanna Division.

B. B. HOTCHKISS, inventor of the famed Hotchkiss machine gun, died on Feb. 14, in Paris, aged 60 years. MR. HOTCHKISS personally superintended the manufacture of his guns at St. Denis, near Paris, where he had 3,000 men employed. He was originally a member of the firm of Hotchkiss Sons, of Bridgeport, Conn., manufacturers of light hardware; he was a member of the Legion of Honor of France, and left an estate of $5,000,000.

SAMUEL M. GRAY, City Engineer of Providence, R. I. gave an informal talk before the Commercial Club of Brockton, Mass., Tuesday evening Feb. 17, on the subject of the Sewer Problem. He described the different systems of disposal now in use in Europe and this country, but declined to make specific recommendations for Brockton owing to the absence of sufficient data. Much interest was manifested by those present and it is hoped that active measures will be adopted soon.

Air Compressing Machinery.

THE Ingersoll Rock Drill Co. have issued a catalogue of Air-Compressing Machinery, illustrated by engravings and phototypes. The pamphlet is really a very practical treatise on compressed air and its uses as a motor, and contains among other things, an illustrated description of the plant put in by this company for the contractors of the Washington D. C., Aqueduct Tunnel now under construction. This is by far the most extensive air-compressing plant ever erected in this country: and, in length of air-mains and power of machinery, is only surpassed by appliances used in driving the great Alpine tunnels. In our condensed report of the progress of the Washington Tunnel, in our last issue, we omitted the description of this plant, simply referring to a previous description of Feb. 16, 1884; but sufficient data is given to show its elaborate nature and the many uses to which this motor is there applied. We recommend the catalogue to all interested in the use of compressed air as of value aside from its professedly commercial purpose.

B. & O. R. R. Bridge, Havre de Grace, Md, Detail of Construction.

BY COL. WM. M. PATTON, ENGINEER IN CHARGE.

In all large structures over water-courses several important questions are to be carefully considered. Where the piers are low and foundations easily secured, with a correspondingly light cost, short spans and an increased number of piers are generally economical, provided that there is no dangerous obstruction to the current due the piers, and that the stream is not navigable On the other hand, where the cost of securing proper foundations is great and much difficulty is likely to be encountered, long spans and the minimum number of piers is best. Sound judgment is required in comparing and deciding upon the particular plan best adapted to the varying local conditions about a bridge site. The location of the B. & O. Bridge, under consideration, presented unusual difficulties, and these were fully appreciated and carefully studied, by Col. H. T. Douglass, Chf. Eng. Philadelphia Branch, B. & O. R. R., before the adoption of the present plan.

The matter of location and general design settled, the contract for the five pneumatic-caisson foundations, (Piers 2, 3, 4, 8 and 9) was awarded to Wm. Sooy Smith & Son, and signed Nov. 20, 1883. The foundation for Pier No. 5 was awarded to Mr. J. E. Robinson, of Baltimore; and the foundations of the land piers were included in the pier masonry contract, awarded first to Smith, Usher & Co., and then transferred by them to Jones, Drake & Co., of New York.

Wm. Sooy Smith & Son, with their usual energy and promptness, at once contracted with parties in Norfolk, Va., for the pine timber required, and on Dec. 10, commenced framing caisson No. 8. Two or three caissons were under construction at the same time.

Caisson No. 2. Taking the caisson construction and sinking in detail, we commence as above:

Framing commenced, Jan, 30, 1884.

Caisson launched, April 2, 1884.

Within this time the outside posts, walls and lining of the air-chamber and one deck course were constructed; the entire lining caulked and the first section of shafts and pipes put in place. The caisson was launched end-wise, resting, on three ways laid with a slope of ¾ inch to 1 foot. No difficulty was encountered, the caisson gliding off easily. The displacement was about 4 feet in depth; previous calculation called for 3 feet 9 inches; the launching weight was 405,250 lbs. After launching, the deck courses, bedded in mortar and grouted, were completed and the caisson towed into position.

Air was let into the caisson, April 29, and the false launching bottom removed on May 2. On May 3, the material at this pier site being of a sandy nature, a commencement was made in the removal of this material by the blowing out process. No pump was used, and the process referred to consisted simply in the removal of the water and sand by opening a valve and allowing the compressed air to lift and force out the material piled around the bottom of pipes arranged for this purpose, and passing through the roof of the working chamber. Gen. Wm. Sooy Smith was the first to apply this process in America, having used it in founding a bridge over the Savannah River in 1859. Care and some experience is required in feeding these pipes so as to avoid a too great loss of air and the choking of the pipes.

Laying of concrete in the crib was commenced on April 28, and completed May 31. In this time 1621½ cubic yards of concrete were placed, an average of 49 cubic yards per day. As the resistance to sinking was great, owing to the sandy nature of the bottom, more weight was required and the masonry was consequently commenced on June 2. No coffer-dam was used on this caisson, the top of the masonry being always kept above the water. The work of sinking and building the masonry progressed simultaneously, and, on June 17, the registered air pressure was 33 lbs. (actual pressure 48 lbs.); in order to permit the caisson to sink with its total weight of 9,356,760 lbs., the pressure had to be reduced to 26 lbs. The uplifting effect of the air pressure being 6,143,904 lbs; and the actual resistance from the material 3,212,856 lbs., the calculated frictional resistance per square foot of exposed surface was 331½ lbs.; the caisson sunk 12 inches and the pressure was reduced to 22½ lbs. On June 18, the north west corner of the caisson was found to be resting on boulders; these were removed from under the cutting-edge, and on June 24, the caisson was sunk 7¼ inches. The caisson commenced sinking at 30 lbs. and stopped at 27 lbs. pressure. Total weight was same as before, frictional resistance per square foot, 234 lbs. At this time the compressors were delivering 589 cubic feet of air per minute. The caisson was sunk 8 inches on June 25; air-pressure 36 lbs., commenced sinking at 24 lbs.; stopped at 13 lbs. frictional resistance 380 lbs. The air-pressure due to the depth was 30½ lbs. and no good reason can be assigned for its increase to 36 lbs. The excess of pressure necessarily caused an increased leakage of air under the cutting-edge, and may account for the decrease in resistance from 331½ to 234 lbs., as a rapid escape of air, tending naturally to follow the sides of the caisson, would loosen the material in contact and decrease the friction. The increase of friction to 380 lbs., on June 25, was no doubt due to the fact that the caisson was well into the boulder stratum and the resistance was due to great local and isolated pressure on the sides of the caisson by these boulders; it could hardly be considered as a uniformly distributed resistance. A similar cause probably brought about the 600 lbs. resistance reported at the East River Bridge foundations.

At the last point named, after consultation

with the Chief Engineer, it was determined to stop the foundation, blocking was placed under the shoulder of the cutting-edge of the caisson at various points in order to bring it to a level, and on July 1, we commenced sealing with cement around the bottom edge of the caisson as a precaution against "blow-outs," while the loose material was being cleaned out. Concreting was commenced on the same date, and by July 5, the air-chamber was completely filled, an average of 33 cubic yards per day being placed. By July 15 the main and supply-shafts were removed; and, by July 19, the shaft-holes were filled with concrete. This latter work was done by lowering a box of concrete into the shaft-holes and emptying the same at the bottom; the box had a bottom door connected by a rope to the hoisting fall by means of a hook above, this arrangement kept the door closed as long as there was any strain on the main-fall, but as soon as the box rested on the bottom the hook was easily detached and the contents of the box dumped by again hoisting on the main-fall.

Below is given the depth sunk; amount of material excavated (not allowing anything for the inflow of material which, according to Mr. Rankine, is equal to or, exceeds the actual displacement); amount of concrete, timber, iron etc., in caisson No. 2.

Depth sunk below low water	63 ft., 3¾ in.
Amount of material excavated	112,124 cu. yds.
Concrete in Crib	1,621 " "
" " Air-Chamber	330 " "
" " Shaft-holes	28 " "
Total concr	1,979 " "
Number of barrels of cement used	2,283 " "
Amount of square timber	348,573 ft. B. M.
" Planking	37,207 " " "
Total timber	385,480 " " "
Amount of iron screw bolts	11,313 lbs
" drift bolts	34,181 lbs.
" spikes	4,638 lbs.
" cast-washers	2,472 lbs.
Total iron	52,604 lbs.
Iron per 1,000 ft. B. M.	136½ lbs.
Average rate of sinking per day	1⅞ ft.

About ⅛ cu. yds. concrete to 1 barrel of cement; proportions, 1 cement, 2 sand.

American Society of Civil Engineers.

RECORD OF MEETING, FEBRUARY 4TH, 1885.

President Frederick Graff in the chair. The death, on February 3d, of Theophilus Sickels, M. Am. Soc. C. E., was announced, and the appointment of a committee to prepare a memoir was authorized.

The paper by E. Sweet, M. Am. Soc. C. E., State Engineer of New York, on the "*Radical Enlargement of the Artificial Waterway between the Lakes and the Hudson River*," was discussed.

Mr. Sweet's paper refers to the fact that for twenty years after the enlargement of the Erie Canal to its present capacity it held a prominent place in our internal commerce. Contemporaneous with its enlargement began the wonderful development of the railway system which has since absorbed much of our best engineering, executive and administrative ability, and much of the available capital of our country, to the exclusion of water routes. The Erie Canal, unchanged for thirty years, except in its gradual deterioration, with unimproved equipment and mode of operation, is gradually losing its capacity for usefulness and its influence upon the problem of transportation. Thirty years ago the Erie Canal carried nine-tenths of the freight between Buffalo and New York: now it carries less than one-fifth of it. Minor improvements have been urged, but its inadequacy to meet the present and prospective wants of northwestern commerce has become so manifest as to demand a far more radical improvement.

To become the permanent highway for this commerce, the canal must have capacity to carry from Lake Erie to the deep waters of the Hudson the largest vessels now navigating the lakes, or as those vessels may probably be enlarged in the future. The canal should be at least 18 feet deep, 100 feet wide at bottom, and with locks 450 feet long and 60 feet wide. It must receive its water from the lake and discharge it into the Hudson. While the changes required are radical, they are entirely practicable and involve no very serious difficulties. The essential change of profile would be in extending the Rome level westward to Lock 57, near Newark, in Wayne County. The only difficulty of importance would be at and near the crossing of the Seneca river, and this would be reduced by a change of location at that point. Probably the best results would be obtained by an entirely new route from Syracuse eastward. From the vicinity of Utica, the Mohawk river should be canalized to the Hudson.

The plan may be summarized as the widening, deepening and necessary rectification of the worst curvatures of the present canal from Buffalo to Newark, about 130 miles; the construction of a new canal from Newark to Utica, about 115 miles; the canalization of the Mohawk river, from Utica to Troy, about 100 miles, and the improvement of the Hudson river from Troy to Four Mile Point, in Coxsackie, a distance of about 30 miles.

The elevation of the western level of the canal, being governed by the surface of Lake Erie, must secure the required depth wholly by deepening, while the profiles of the levels from Lockport east can be adjusted to meet the economical requirements that will be disclosed by detailed surveys.

The first level, from Buffalo to Lockport, will be 32 miles long. Descending from this level at Lockport, by two locks, each of about 25 feet lift, the second level of the canal will be reached. This level, 64 miles in length, will extend to Brighton, where, descending by two locks of about 24 feet lift, we reach the third level of the canal, extending from Brighton to Macedon, 20 miles; there, descending by a lock of about 20 feet lift, we reach the fourth level, extending from Macedon to Newark, 12 miles, where by a lock of about 20 feet lift, is reached the level of the proposed new canal, to extend from Newark to Utica, about 115 miles, which will be the fifth and longest level of the new canal. From that point the Mohawk river (except at Little Falls and Cohoes, where combined locks will be required) can best be canalized through locks of 10 or 12 feet lift, making pools having an average length of about 5 miles each.

The construction of this great artificial river, more than 300 miles long, is a vast enterprise. Its cost may be roughly assumed at $125,000,000 to $150,000,000, and its probable tonnage at 20,000,000 to 25,000,000 of tons per annum.

The first requisite to the possible inauguration of this enterprise is a careful system of surveys. The canal should be under the control of the State of New York, and that State should without delay cause the necessary surveys and estimates to be made.

By means of the enlarged canal, cargoes would be carried from Chicago to New York in less time and at less cost than can now be done by canal from Buffalo to New York. With our widespread territory, cheap transportation is a necessity; and the Erie Canal should be given the necessary capacity to effectually secure that result.

Mr. E. L. Corthell, M. A. Soc. C. E., considered that the day of canals had passed; that the developement of railways had rendered any expenditure upon the Erie Canal useless; that it would be better and more economical for Government to give the public railway facilities without the charges for capital, or to construct, or utilize some of the present railway constructions, as barge and ship railways. He gave data showing the time occupied by vessels passing through the Suez Canal, thence arguing that the length of time which would be required for transit through the proposed canal would effectually prevent it from affording the expected relief to commerce.

Mr. Edward P. North, M. Am. Soc. C. E., took the ground that the increase in volume of tonnage and the decrease in cost of freight were inter-dependent, citing tables of prices and quantities fortifying his position; and also that the increased volume of tonnage had closely followed the building of land grant railroads and the improvements of lake harbors. He cited the deductions from Gregory King's celebrated estimates in the variations in the price of corn, showing that an addition of 100,000,000 bushels of wheat lowers the price, when at $1 to 92 cents, and when at 85 cents to 80 cents. He quoted the report of the House Military Committee of 1862 on the political necessity of a ship canal within the territory of the United States. He gave data as to the terminal cost on wheat in the Port of New York and also as to the transatlantic carrying trade, and spoke of the desirability of securing the carrying trade from Manitoba.

Mr. Willard S. Pope, M. Am. Soc. C. E., referring to a letter from General O. M. Poe, M. Am. Soc. C. E., alluded to the intention of the Government to obtain ultimately a minimum depth of 20 feet of water at all lake points. He showed, by giving dimensions and capacity of lake vessels, that their increased draft and load had closely followed the practicable depth of water. The proposed canal, therefore, should provide this depth of 20 feet. This increased requirement as to depth would probably increase the cost to perhaps $200,000,000. The plan is magnificent, but the true purpose should be to secure a sufficient water connection between the Atlantic and the lakes, or, more definitely, say between Buffalo and Liverpool. Between these points by way of the Erie Canal is 3,450 miles; by way of Montreal and the Gulf of St. Lawrence, 3,180 miles, the latter making a saving of about one day in time. Both routes would be closed by ice for about the same period. The lockage would be same. The Welland Canal is 28 miles long and the canals round the rapids of the St. Lawrence aggregate 41 miles, making 69 miles of artificial waterway; from Buffalo to deep water on the Hudson River is 315 miles, a saving in favor in the Montreal route of 246 miles of canal work. The St Lawrence route would secure the trade of the whole of Ontario, none of which could be reached by the Erie Canal. Over the Erie Canal numbers of costly bridges would be required; very few on the Canadian work. On the long levels as the Erie Canal the banks must be protected; on the other route, the long reaches are in the main river where no such protection is required. A break in the embankment of the Erie Canal would be disastrous where its level is above that of the surrounding country, which must frequently be the case; no such difficulty exists on the other route. Finally, about six times the amount of money would be required for the Erie route as compared with the St. Lawrence. If the object is to gratify what may be called a patriotic sentiment, then the Erie route must be taken; but if the object is to secure cheap, rapid and reliable transportation we must go to the other route. The Suez Canal was built upon a foreign soil; the Panama Canal is progressing through a foreign soil; the Nicaragua Canal is projected through a foreign soil, and if it should be necessary, the United States can protect her interests on the St. Lawrence route.

The letter of Gen. O. M. Poe, M. Am. Soc. C. E., referred to by Mr. Pope, states that the draught of vessels on the lakes is constantly increasing with the available depth of water in the navigable channels, and the tonnage has rapidly increased facilities of navigation.

In 1857, a vessel carrying 25,000 bushels of wheat was considered as large, proportionately, as one now carrying 75,000 bushels, but the limit has not yet been reached, nor will it be until the channels have a navigable depth of 20 feet. This must be looked for in the near future, works in that direction being now in progress. We will then have vessels loading with 4,000 tons instead of 3,000, which some now carry.

To produce the best results, the water way from the lakes to the ocean should be made for 20 feet depth. This would permit the passage of vessels drawing 18 feet of water.

Mr. T. C. Keefer, M. Am. Soc. C. E., described the construction of the Canadian canals, and the method of shore protection by means of stone broken a little larger than ordinary Macadam.

Mr. Simon Stevens gave the results of an inspection of the Caledonian canal, and stated that a speed of from 7 to 13 miles was attained upon that canal. He also described the method of shore protection there, which was by large quarry stone not regularly laid, but pitched upon the bank. He also suggested the great difficulty in navigating, with long vessels, a canal whose curves were not of extremely long radius.

Mr. E. H. Walker, Statistician of the New York Produce Exchange, by letter, said that an improved canal is much to be desired, and that the canal suggested by Mr. Sweet is possible, but that it would be too expensive, and its construction too slow for the requirements of the country, and that when constructed, it would be found unserviceable, because it would not be economical to run large lake vessels through it. Such vessels, carrying 75,000 to 90,000 bushels of grain, would cost upwards of $100,000 each, and would require a crew of from 25 to 30 men. They would, in an artificial channel, move slowly, and the round trip between Lake Erie and the Hudson could possibly be made in a month, The cost of transfer of grain does not exceed ¼ of a cent per bushel from lake vessels to canal boats. An improvement of the present canal, making it with 10 feet depth of water using the present locks to the extreme length their walls would allow, using steam canal boats and tenders of good model carrying from 18,000 to 20,000 bushels of grain, would make the round trip between Lake Erie and New York practicable in from 8 to 10 days. The cost of the tow-boats would not exceed $15,000. The number of crew would not exceed from 4 to 6 men. The result could be attained in two years. The cost would be between $1,000,000 and $3,000,000, against the enormous cost of the proposed ship canal.

It was announced that additional discussions on this subject had been received from Messrs. O. Chanute, E. S. Chesbrough, Thomas C. Clarke, M. M. Drake, N. M. Edwards, Walton W. Evans D. Farraud Henry, Clemens Herschel, Colonel William E. Merrill, Messrs. J. Nelson Tubbs, and John D. Van Buren, Jr. Also that a letter had been received from Mr. William P. Shinn, promising discussion, and a message from Mr. William J. McAlpine, saying that he had expected to be present and take part in the discussion, but was prevented by illness. It was also understood that there were other members who were prepared to join in this discussion.

On motion, it was resolved that the discussion be continued at the next meeting of the Society, on the evening of February 18.

JOHN BOGART,
Secretary Am. Soc. C. E.

Liverpool Engineering Society.

The usual fortnightly meeting of this society was held on Wednesday, 28th January at the Royal Inst. Colquitt Street, Mr. W. E. Mills, President, in the chair. A paper by Mr. E. B. Ellington, M. I. C. E. on "Recent progress in the Public Supply of Hydraulic Power" was read by the author.

Rather more than four years ago, the author read a paper before the Liverpool Engineering Society, descriptive of the operations of the Hull Hydraulic Power Company, who were the first to supply hydraulic power for the use of the public at large. Up to the time when that paper was read, partly owing to bad trade and partly to the conservatism of most of the warehouse keepers, the growth of the undertaking had been slow, but it was continuous and since then uninterrupted prosperity has attended the public supply of hydraulic power. No consumer has abandoned the use of the power except from causes beyond his own control, and the great economy of this system of supplying power to the public has been fully established.

The author exhibited a diagram showing the quantities pumped into the mains every week from July, 1882, to the present time, also showing the total quantity delivered during each quarter and the proportion of those quantities registered and unaccounted for. The efficiency of the system under continuous work is shown by the fact that the percentage of water unaccounted for last quarter was less than in any previous record. During the whole time there has been no failure of supply.

The chief novelty in connection with the work in Hull is the recent determination of the Corporation to avail themselves of the public hydraulic power for extinguishing fires. The water from the main cannot conveniently be used direct for the purpose, its volume being insufficient and its pressure too great. By using Greathead & Martindale's Patent Injector Hydrant, of which a diagram was exhibited, water from the ordinary town supply can be thrown at the rate of 150 gallons per minute, through a nozzle one inch in diameter to a height of 80 feet. The author expressed his opinion that this application of the power is calculated to be of great public service and that would in time be widely extended both in Hull and London, though in the city of London the water-works company does not regard this system with any favor.

The author in his previous paper had alluded to Liverpool as being admirably adapted for a public system of hydraulic mains, he stated that with the concurrence of the Corporation the necessary Parliamentary powers had now been obtained and preliminaries arranged, and that it may be expected that before long the system will be in operation in Liverpool. A plan was shown of the proposed areas of supply in that city.

The author then proceeded to give an account of the large works for hydraulic power supply carried out in London during the last two years, which involved the consideration of many questions with which it would have been almost impossible to deal but for the experience obtained in Hull. Ten miles of mains are now under a pressure of 700 pounds per square inch in the streets of London. The main pumping station is on the south side of the Thames, and power is supplied to the north side by two mains laid over Southwark Bridge. Two independent mains serve the district south of the river. All these mains are in communication with the two accumulators at the pumping station. The pipes are laid in circuit, with stop-valves at frequent intervals so that in the event of leakage only that portion of the main between two stop-valves is thrown out of use, a temporary repair can be effected in two or three hours, a bad pipe can be removed and replaced by a new one in from six to eight hours according to the character of the paving. Repairs are of rare occurrence and during nine months of last year there was no failure.

The author exhibited a new form of pipe joint which he had designed, which without increasing the weight of the pipe makes the ultimate breaking strength about 50 per cent. greater.

A description was then given of the pumping, engines which are of the three cylinder inverted vertical type, compound with surface and direct acting pumps.

There are at present erected three sets of engines, each of about 200 horse-power.

Allusion was also made to an installation at Kensington Court Estate, London, where each house is provided with an hydraulic lift of special construction for domestic use, the power being supplied from a pumping station erected on the estate.

The author then gave a number of facts from actual experience proving the great economy of the system, and pointed out that in buildings within reach of the mains, hydraulic lifting machinery was being adopted in preference to any other, that several firms whose cranes and lifts were until lately worked by hydraulic power from private pumping plant, have discarded the use of their own engines and accumulators in favor of the public supply, that machinery formerly set in motion by gas engines or by steam engines driven from gas, or coal-fired boilers had been altered to utilize the public supply, and that hydraulic lifts and cranes on the low-pressure system worked from tanks filled either from the Water Company's mains or by pumping engines on the premises had been converted into high pressure machines, the effect of the alterations in every case being a marked economy in working.

CORRESPONDENCE.

Chronology of the Water Jet.

PROVIDENCE, R. I., Feb. 16, 1885.

EDITOR ENGINEERING NEWS.—In the issue of Feb. 14 referring to the "Chronology of the Water Jet," among the early applications of the jet to engineering operations you mention that at Pungateague Lighthouse, Chesapeake Bay, and credit Mr. Charles Pontez with the suggestion.

I have been frequently told by Mr. G. Castor Smith, who was in charge of the construction of the Pungateague structure, that he claimed the suggestion himself and was credited with it by some at least of the older Army Engineers. He declined to certify that Mr. Pontez or Pontzen was the inventor when the latter wanted to secure a patent on the process.

The circumstances of application were these. The original intention was to sink the hollow cast iron piles by exhausting the water from the inside of the pile when it was thought the scour of the water rushing in around the bell shaped bottom would allow the pile to sink. To accomplish this exhaustion suddenly a reservoir was provided from which the air was pumped and connection was suddenly made with the pile.

The process was, however, unsuccessful and the tube having become filled with sand, at Mr. Smith's suggestion, a stream of water was turned into it to clean it out, when, much to the suprise of all present the pile went down.

So that the discovery in this case was purely accidental, and I am under the impression that Mr. Pontez was not present at the time.

Mr. G. Castor Smith is the oldest living employe in the Lighthouse Service, having entered it when it was under the control of the corps of Topograhical Engineers, before the organization of the Lighthouse Board. He is still in the same employ performing duties suitable to his advancing years in the office of the Engineer of the 4th District, in Philadelphia.

Very respectfully,
EDWIN PARRISH.

One Cubic Yard of Concrete from one Barrel of Cement.

HAVRE DE GRACE, Feb. 16, 1885.

EDITOR ENGINEERING NEWS:—In an article on the caisson, etc., published in your journal of the 7th inst., I stated average yield of concrete in cubic yards per barrel of cement, expecting and intending to follow this with detailed results for each caisson. In this article I stated that, generally, one yard of concrete was made from one barrel of cement. Mr. H. H. Carter seemingly takes exception to this statement alone or when coupled with a statement of proportion used, though at the same time he admits the truth of both. With this admission in one line, I fail to see the significance of the question in the next.

A box 9×3×1 ft. was filled with broken stone; this was then mixed into concrete, using one barrel of cement and two barrels of sand, the mixtures after being rammed into the same box practically filled it, neither more nor less. This statement was then qualified by saying that the actual amount of cement required would depend materially upon the size of the broken stones, and whether or not it was screened. In regard to the statement of proportion used, you either did not publish what I actually said, or I failed to say what I intended. I think I said, "when mixing *by hand* we used the proportions of one cement, two sand and five of broken stone." I do not remember stating the yield in concrete; the concrete, thus mixed, was a very small part of the entire quantity used.

As we used a considerable quantity of large stone, it would be a little difficult to say how much space would be occupied by a given bulk of concrete rammed between and over these stones. The entire mass was called concrete, and our measurements and records show an average yield of one cubic yard to a barrel of cement, the proportions being one cement, two sand. In the detailed report on Caisson No. 2, it will be seen that the yield per barrel falls somewhat short of one cubic yard. The broken stone here used was well screened; in other caissons the stone was not screened As to the manner of proportioning the stone when mixed by machinery, the published statement seems to be sufficiently explicit not to be misunderstood.

Yours truly,
W. M. PATTON.

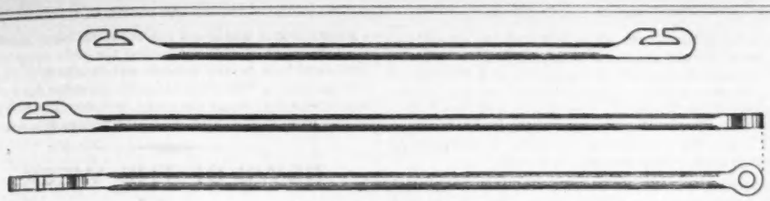
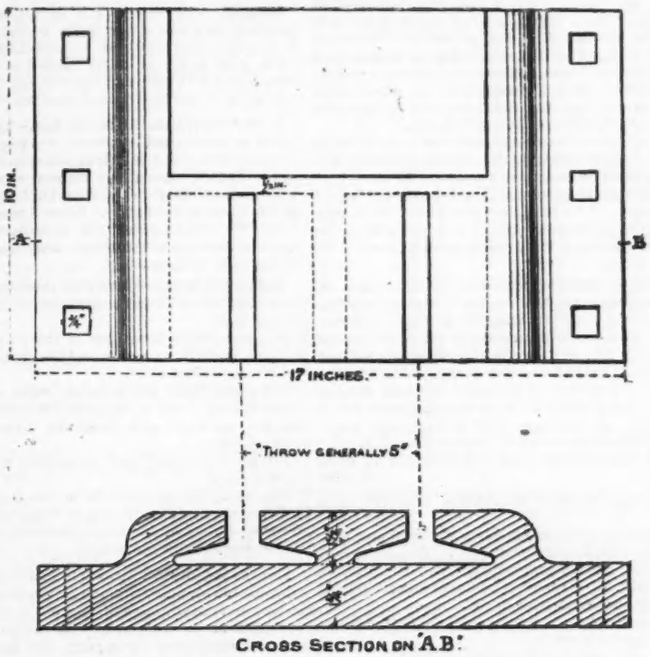
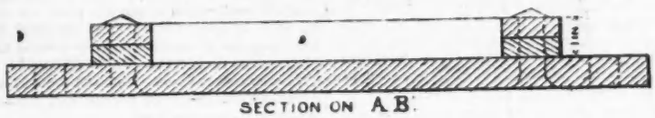


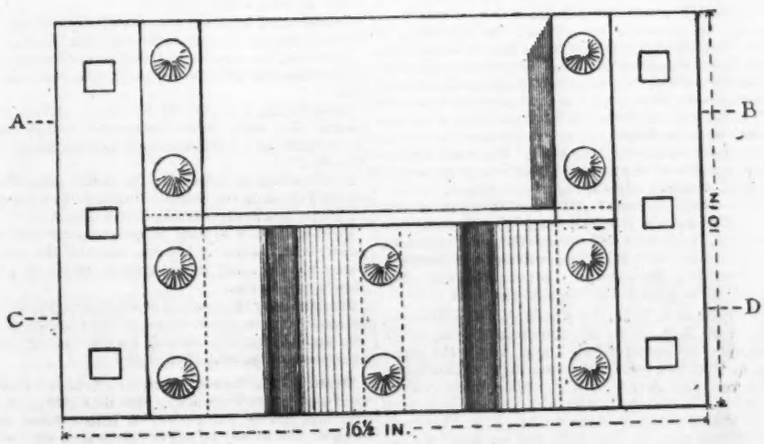
FIG. 58.—CONNECTING RODS.

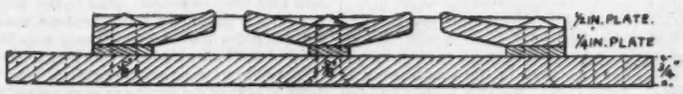


CROSS SECTION ON 'AB.'

FIG. 59.—CAST-IRON HEAD CHAIR.







SECTION ON CD.

FIG. 60.—WROUGHT-IRON RIVETED HEAD CHAIR.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 109.*)

For the switch rails it is best to use two 30 foot rails in order to be able to spike as much as possible. The unspiked parts are held together by "Switch-Rods" at least four, better five, and the toe end connected with the switch stand by a "Connecting Rod." These rods, Fig. 58, should be made of iron either round, about 1⅛ inches in diameter, or each angular 1¼ inches square, and weigh each about 35 lbs. for standard gauge. They can be made at the rate of a set of four switch and one connecting rods per days of one forge. The jaws on switch rods are sometimes punched out from a solid toe which process however does not give as satisfactory results as turning them over by hand. Rivetted work is also done, the bar being a strap of at least 2 in. by ⅝ inches with lugs forming the jaws rivetted on. They are inferior to welded rods. Rod No. 1., which is nearest the head-block, and the connecting rod should be made to fit the base of the rail exactly without any lost motion whatever and be promptly changed should it wear loose. The rods back of No. 1, should be made so that the trackmen can drive them on without using force, and to hold the moving rails in exact gauge unless it be a turnout from the inside of a curve where the gauge needs widening. If the switch is subject to hard or fast running, No. 1 rod should be doubled. For if this rod breaks, and it does sometimes, the ends of the moving rails are uncontrolled and an accident is sure to result. The rods toward the heel need not be as large as No. 1, but it is just as well to have one size throughout in order to avoid carrying several styles on hand, or give some careless trackman the opportunity to put a weak rod where a strong one is required. As all old roads have several patterns of rail in use the trackmen should be supplied with thin tapering wedges of iron, about 3 inches long, to drive between the edge of the rail base and the jaw in order to make a tight fit in case they are obliged to use large size rods on small rails. These wedges, called keys, should be avoided as much as possible, especially on No. 1 rod, except for temporary purposes until the proper size rods are obtained, as they are liable to drop out and give trouble.

The head block on which the toe of the moving rails rests is a substantial piece of timber about 14 to 16 feet long according to the design of the switch stand. Its fall must be broad to give head chairs and switch stands a good bearing, and its thickness be sufficient for stiffness; 12 inches and 8 inches answer satisfactorily. It is objectionable to get the head blocks thicker on account of the effects of frost in the winter. The head chairs were formerly always made of cast iron of general design as in Fig. 59, their weight being about 80 to 90 pounds. In order to diminish weight and given a less refrangible material, malleable iron is substituted for cast-iron so that the weight is reduced to about 50 pounds for a substantial article. In cold weather and if the head block gets worn, then cast and even malleable iron chairs break very easily and are an element of danger and great expense. To prevent this, wrought-iron rivetted chairs, Fig. 60, are used. They soon repay their extra prime cost. A simpler and less expensive chair than this is the design (patent applied for) of Mr. W. H. Starr, Fig. 61,* which can be stamped out by a steam hammer or even easily rolled. To prevent running, the two fixed rails or "stub rails" are bolted together with a cast filler of proper dimensions between them, and fish plates on the outside; while a wrought-iron stirrup or band ¼ inch to ⅜ inch thick goes

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*Figs. 61 and 62 are unavoidably crowded out of this issue; we will give them next week.

around in front with the double purpose of extra security and preventing the moving rails from catching should they expand so as to bind. This arrangement is shown in detail in Fig. 62. Spikes driven through the holes in the plate hold the stub rails securely. The chair is either right or left, and the dotted lines in Fig. 61 show the positions of the rails and how the spike holes are fixed. Of course the spike holes are punched to suit the rail base.

(TO BE CONTINUED.)

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E

Continued from page 109.

DCCXXIII. GRAND HAVEN, MICH.

Grand Haven, Michigan, in lat. 43° 3′ N., long 86° 15′ W., the county seat of Ottawa County, is on Lake Michigan at the mouth of Grand River and has one of the best harbors on the lake. The principal industry is the manufacture of lumber.

Water-works were built by the city in 1880, taking the supply from ground water.

A number of wells of 2½ inch pipe with perforated points 6 feet long, driven to a depth of 32½ feet in 4 lines radiating from the pump, are connected by horizontal suction pipes of 6 and 4-inch diameter, and terminate in a vertical chamber 24 inches in diameter and 6 feet long, provided with a 2-inch valve near the bottom to allow it to be cleaned out. Near the top of this chamber the pumps are connected. They are three in number each of 14-inch steam and 8-inch water cylinders and 12-inch stroke, made by M. Walker, and deliver directly with the mains, furnishing an ordinary pressure of 40 and a fire pressure of 120 lbs.

Distribution is by one mile of cast-iron and Wyckoff wood pipe, with 10 fire hydrants and 45 taps. Wrought iron is used for services. The works have cost $10,000. The yearly expenses of maintenance are $2,500, and the receipts $500. The daily consumption is 140,000 gallons. A. L. Holmes is Superintendent.

New works were built in 1884 by a private company, taking the supply from driven wells. The company has laid 8 miles of cast-iron pipe with 60 fire hydrants and 100 taps. Galvanized iron is used for services. The city pays $70 yearly for the use of each hydrant. The bonded debt of the company is $70,000 at 6 per cent. The yearly expenses of maintenance $2,000 and the receipts $5,000. The population in 1880 was 4,862. S. L. Wiley is President and Geo Van Patten, Superintendent.

WATER.

ST. PAUL.—The bill to authorize the council of St. Paul to issue $800,000 bonds to improve its water-works has passed both houses of the Minn. Legislature.

THE Rochester Water Co., Stafford County, N. H., has decided to obtain its supply from Round pond. The capital stock, $100,000, has all been taken, Hon. Frank Jones, of Portsmouth, N. H., investing $50,000.

THE Frankfort, Ky. Water Company commenced laying pipe on the north side of the river on the 8th. The reservoir and mains are to be completed by the 1st of July. The reservoir has an elevation of 270 feet above the level of the city. When the works are completed the city will do away with the steam fire engines.

THE frost has apparently gone deeper into the earth this winter than any winter since the construction of the present water-works. Citizens are haunting the office at the City hall with the words "frozen pipes" depicted in their very countenances. Places that were never touched before are now suffering. On macadamized roads the frost has struck in to a depth of about five feet.—Toronto *Mail*.

ON the recommendation of Consulting Engineer Hill and Superintendent Boeh, of the Cincinnati Water Works, the contract for two new pumping engines of ten million gallons capacity each has been awarded to Robert W. Wetherill & Co., of Chester, Penn., at their bid of $39,000.

THE most cheering sign of the times was the resumption of work at the pipe works yesterday. A force of seventy-five hands was put to work and one pit will now be operated, with prospects of the entire plant soon being in operation with one hundred and fifty hands. The company yesterday received a contract for 4,000 feet of pipe for the Huntsville Gas Works, and the Huntsville Water Works Company yesterday had representatives in the city negotiating for pipe. The inquiry for orders is good.—Chattanooga *Times*, 10th.

SAVANNAH, GA., WATER SUPPLY.—Extensive additions to the water supply have been made. New mains have been laid extending 11,926 feet. Of 16-inch pipe 9,001 feet have been used, 1,050 feet of 10-inch pipe and 225 feet of 6-inch pipe. Extensions of 9,235 feet of 6-inch pipe, 420 feet of 4-inch pipe and 767 feet of 12-inch pipe have been made. Thus it appears that 21 748 feet or 4⅛ miles of pipe, have been added to the means of supply during the year. This addition to the old pipes makes 32⅛ miles of pipe now laid. Seventeen new fire hydrants have been put on the line of the new mains.

The outlay for the improvements has been $36,426.61 and for the extensions from the mains $5,037.34. The expenses proper for operating the water-works not including the $5,037,34 above mentioned have been for the year $19,567.83. The receipts from water rents have been $49,637.38. The management and working of the department have been highly satisfactory. *Annual Report of the Mayor.*

THE Blethen House Water-works Co., who have applied to the Maine Legislature for a charter, contemplate laying pipes in the villages of Dover and Foxcroft, Me., for supplying pure water for domestic and fire purposes. Mr. Blethen has already expended over $1000 in supplying the hotel and has no doubt that the capacity of the springs is sufficient for both villages. They are situated only one mile distant on the Hind's Hill and give an abundant flow of pure, soft water. Dover and Foxcroft are to be congratulated on their prospective water-works system obtained at so small an expense.

THE following bills have been passed by the St. Louis Council:

To establish the following sewer districts and construct sewers: Branch district No. 22, Illinois avenue district No. 4, Ohio avenue district No. 11, Chippewa street district No. 3, South Chambers street district No. 6, Elliott Avenue district No. 33.

To purchase 100 tons of special castings for the Water Works at a cost of $6,000.

To erect a new water tower to cost $13,000.

The citizens of Oakland, Me., have been somewhat agitated over the matter of Waterville's "Water Co." which, it seems, was quietly chartered four years ago. A very heavy remonstrance has been placed in the hands of Oakland's representative, A. P. Benjamin, esq. The matter has been adjusted and a new bill drawn that will be satisfactory to both towns.

AN act to supply the city of Bath, Me., with pure water has been passed.

CHIEF ENGINEER LUDLOW, of the Phila. Water Dept., explains the lack of water in some of the city reservoirs by the unprecedented packing of drift-ice against the gratings and entrance to conduits of the various pumping stations on the Schuylkill River. He further says that the reservoirs are so small that a twenty-four hour stoppage in pumping would leave the city without water. In view of this danger in the future he calls the attention of Councils to the great importance of at once getting to work on the proposed Cambria Reservoir; this basin, with forty acres of land required at $6,000 per acre, would cost about $940,000, but would give a storage capacity of 200,000,000 gallons at an elevation sufficient to practically supply the entire city. The main trouble in pushing this matter lies in the fact that funds would have to be raised by negotiating a bonded loan.

At the same meeting of the Water Committee bids were received from H. Kavenaugh for cleaning the Fairmount, Corinthian and Spring Garden reservoirs for $5,600, $4,400 and $2,316 respectively, and March & Bro. offered to do the same for $1.50 per cubic yard. The contract will be awarded at the next meeting.

THE PITTSFIELD, N. H., AQUEDUCT CO. The *Analecta*, of Pittsfield, N. H., gives the following account of its water-works:—Chartered July 2, 1870, under the name of the Pittsfield Aqueduct Co. After the re-organization of the Company, May 27, 1884, a contract was entered into on May 29, with the Connecticut Patent Water-pipe Co., for the construction of the works. N. W. Ellis made the necessary surveys, and work was commenced June 12, under the supervision of S. G. Winslow, Superintendent for Pittsfield.

The water is obtained from Berry Pond, 400 feet above the main street and 2½ miles distant. A distribution reservoir is constructed in a ravine at a lower elevation than the Pond; its capacity is 1½ million gallons. By Nov. 1884, the reservoir was completed and water turned on to about two-thirds of the distribution system. The total length of pipe laid, from 10 to 4 inch, is 26,691 lin. feet; 4,440 feet of service connection, from 1½ to 1¼ inch, has also been laid. The pipe used in the construction of these works is "cement pipe," the iron being protected on both sides by pure cement; this compound pipe is then enclosed in an outer shell of iron coated with asphaltum. There are in the system, 30 gates, and 27 fire hydrants, made by the Ludlow Valve Co. Population and daily consumption are not stated.

MINNEAPOLIS was given the right to issue bonds, in such amounts, at such times and for such purposes as may seem best to the council, within the law; the following, among others are amounts specified for various improvements; water purposes, $150,000; North Minneapolis sewer tunnel, $140,000; other sewers, $100,000.

NEWS OF THE WEEK.

Miscellaneous.

Drainage.—Engineers are surveying the Dakota county slough with a view to its permanent drainage. It is proposed to construct a twelve foot canal, five feet deep, with a fall of thirty inches to the mile. The length would be four and a half miles. It would drain 4,800 acres of land and cost about $4,900.—Omaha *Bee*.

A Pennsylvania Dam Breaks.—The Lenni dam broke on the 9th and let a flood of water escape, carrying destruction and consternation with it. The trestle-work on the Chester Creek railway was carried away. A temporary bridge of the Philadelphia and Baltimore railroad was washed away. From Lenni to the Delaware river, eight miles, the damage is extensive to manufacturing establishments, dwellings and railroad and country bridges.

Minnesota Items.—Bills were introduced in Minnesota Legislature January 10th, action being taken as stated below.

Bill authorizing the village of Tracy, in Lyons county to issue bonds for sewerage and fire protection. Passed under suspended rules.

Bill authorizing the Winona board of education to issue $15,000 bonds to provide for additional schoolhouses, grounds and furniture, passed under suspended rules.

Bill appropriating $3,000 to improve a road in Mille Lacs county.

The committee on public lands reported favorably the amendment to Senate's bill to transfer swamp lands from the Duluth and Winnipeg to the St. Paul, Brainard and Northern R. R. companies.

Improving Boston Harbor.—The Secretary of War transmitted on the 10th to the House the report of the survey and examination of Fort Point channel, Boston harbor, made in accordance with the provision of the river and harbor act of last year. The examination was made by H. T. Bothfeld. The project contemplates the excavation of a channel 175 feet wide from a point opposite Rowe's wharf to a point near the draw pier of the Federal street bridge. The object of the proposed improvement is to accommodate vessels drawing from eighteen to twenty-two feet at all stages of the tide. The engineer reports that the improvement can be made at a cost of about $100,000, and recommends that that sum be appropriated.

Nebraska Items.—LINCOLN, Neb., February 11.—Following bills are now before the Nebraska Legislature.

Providing for a central asylum for the insane at Columbus and appropriating $100,000 for the same.

Appropriating $30,000 for the erection of two additions to the Kearney reform school.

Establishing a normal school at Red Cloud, providing, the town put up the cost of the building, $14,000.

Providing for a geological and mineralogical survey of the State, the chief to receive $2,000 a year; assistant $800.

Establishing the Central Nebraska asylum for the insane, the place to be designated by the board of public lands and buildings, and appropriating $100,000 therefor.

Establishing an asylum for the feeble minded at Beatrice, providing the citizens donate forty acres of land for a site, and appropriating $35,000 therefor.

Providing for a system of sewerage for the capitol jointly with the city of London, one-half the cost to be borne by each, and appropriating $25,343 to pay the State's proportion.

Providing for the location of a lunatic asylum at York on condition that eighty acres of land are given for a site, and levying one-half mill for 1885-6 to carry out the provisions of the act.—Omaha *Bee*.

Death in the Sewer.—CHICAGO, Feb. 12.—Five men were asphyxiated in a sewer late this afternoon. Several days ago the main sewer in Kinzie Street became clogged, and to-day a gang of eleven men were sent to clean it. Nine went into the sewer with a scraper fitting the conformation of the sewer, dragging it from manhole to manhole, while the other two remained above ground to draw up the mud and dirt through the manholes.

Between Halstead and Union Streets an unusually long time was consumed. Finally, the foreman bending down at the mouth of the manhole, heard a cry for aid, and going down, found the men near the opening, some of them gasping for breath and others lying dead.

There was a strong smell of gas. A rope was passed down to him, as the survivors were unable to climb up the ladder. After two had been assisted up, the foreman found himself falling from the effects of gas, and was obliged to go to the surface. Another man went down and rescued three, and a third assisted the remaining five.

Four were dead when brought up and another died soon after. The names o the dead are:

Michael Laski, Joseph Gill, James Grady, Daniel Curtis, Matthew Mason.

All are married except Gill. The survivors say their first intimation that anything was wrong was when Gill dropped dead. It is not known whether the gas in the sewer was an accumulation of ordinary sewer gas, or illuminating gas from a leaking pipe, or what is known as fire damp.

A Hog Exploded.—"Talk about dynamite, I can tell you a true story of what nitro-glycerine once did in our State. It was out near Prairie du Chien, where they were blasting on the Chicago, Milwaukee and St Paul road. The contractor had several kegs of the stuff in an under-ground place. One day a workman left the place open; by and by some hogs came along, found a keg open, and, as glycerine is as sweet almost as honey, the animal filled himself. He came out by and by and soon wandered into a stable which contained about forty horses belonging to the contractor. The hog got fooling around among the horses' hind legs, when one of them drew off and gave Mr. Hog a good one. The concussion started the business, and not a vestige was ever discovered of the hog or of a single horse or the stable. And where the stable once stood there was a hole in the earth 50 feet deep and 200 feet in circumference. Fact, gentlemen!"—*Madison Democrat.*

Contracting.

Public Building.—The bill containing an appropriation for a public building at Augusta, Me., passed the House.

Pig Lead.—Contract for 50 tons of pig lead for Boston Water-works awarded to Boston Lead Co. for 3.73 c. per pound.

The Tennessee River Bridge.—The bill to authorize the county to issue bonds to build a bridge across the Tennessee, on a vote of a majority in the county authorizing it, has passed two readings in the Legislature.

R. R. Contracts.—Contracts are being let, for ties, culverts, etc., for the Burlington, Lafayette & Western Road. Those interested say work will be commenced soon and pushed rapidly. This is the Lake Erie & Western railroad extension.

Proposed Railroad from Suakim to Berber.—The British government have received proposals from contractors to build a railroad from Suakim to Berber at the rate of twenty miles per day if guaranteed military protection in the work.

Florida R. R.—The citizens of Brooksville, Fla., have appointed a committee to make arrangements for the building of a railroad from Pemberton Ferry to Brooksville, and have agreed to take $60,000 of the first mortgage bonds.

Mayor Whiteside, of Chattanooga, Tenn., has held a consultation with the contractors who are laying the Belgian block pavement in Atlanta, in reference to laying a block as an experiment in that city. They have agreed to do so, if satisfactory negotiations can be concluded, and will hold a conference with the city authorities in a few days. The Mayor favors laying one block on Ninth street with the cubic blocks.

Contractors' Suit.—In the Memphis, Tenn. Circuit Court, J. B. Neely, R. C. McCalla and John Donnelly, composing the firm of J. B. Neely & Co., railroad contractors, entered suit against the Louisville, New Orleans & Texas Railroad for $75,000, which they claim is due for the construction of fifty miles of trestle-work along the line of the road between Memphis and New Orleans.

Sale of Condemned Naval Vessels.—Bids were opened at the Navy Department for the purchase of condemned naval vessels. Those offered for sale were the Colorado, Cyane, Florida, and Niagara. Three bids only were received, two for the Florida and one for the Colorado. Edward Lee Barr, of New York, bid $42,000, and E. Stannard, of Westbrooke, Conn., $41,508, for the Florida, the appraised value of which was $41,000. Mr Barr's bid was accepted. Mr. Stannard bid $26,700 for the Colorado, the appraised value of which was $25,600, and his offer was accepted.

Iron Work of Navigation Pass..—Abstract of proposals for Iron Work of Navigation Pass of Dam No. 6, Great Kanawha River, W. Va., opened 12 M. Feb. 14, 1885, at U. S. Engineer Office, Charleston, W. Va.:

No. 1.	Pittsburg Bridge Co., Pittsburg, Pa	$10,822.50
" 2.	Scaife Foundry & Machine Co., Limited, Pittsburg, Pa	17,850.00
" 3.	T. H. & W. J. Carlin, Trustees, Allegheny City, Pa., (Only Cast-iron)	3,686.00
" 4.	The Snead & Co. Iron Works, Louisville, Ky.	10,404.80
" 5.	The Tredegar Co., Richmond, Va	13,795.00
" 6.	Queen City Bridge & Steam Forging Co., Cincinnati, O.	11,117.50
" 7.	The H. A. Ramsey Engineering Works, Baltimore, Md	13,516.50

Retaining Wall.—The Drainage Committee, Savannah, Ga. Council, reported a resolution, which was adopted, authorizing the Clerk to advertise for proposals for the rebuilding of the retaining wall of the Blibo canal. The necessity for extensive work on the canal is apparent to the Council, and steps are being taken to begin at once.

Cost of Esquimalt Graving Dock.—The total probable cost of the graving dock at Esquimalt will be $665,000, from which is to be deducted $187,136 expended by the Dominion to 31st Dec., 1883, and $243,000 to be provided by the Imperial authority, leaving the probable net cost to be $234,863.

Toronto, Can., Board of Public Works.—The recommendation that an asphalt pavement be laid on Wellington street between Bay and Church streets on the initiative principle, to cost $22,100, was challenged. The pavement will be laid on a concrete bed with stone kerbing.

The tender of Richard West, for sand and gravel, was accepted, at 60 cents per cubic yard for clear sharp sand, and 75 cents per cubic yard for coarse sand for paving purposes.

A. J. Brown's tender for cements were accepted as follows:—Portland cement, $3.25 per barrel; Rosendale, $2.15; Thorold, $1.35.

A. W. Godson was awarded the contract for brick at $7.90 per thousand.

Burns & McCormack were awarded the contract for sewer pipes at the following rates:—Six-inch, 10½c. per foot; six-inch elbows, 40c. each; nine-inch, 22c.; nine-inch elbows, 83c.; twelve-inch, 33½c.; twelve-inch elbows, $1.10; fifteen-inch, 52c.; fifteen-inch elbows, $2.08; eighteen-inch, 67½c.; eighteen-inch elbows, $2.45.

James Wood was awarded the contract for cast and wrought iron work, per hundred pounds, at $1.65 and $3 respectively.

S. S. Martin was awarded the contract for nails at $2.45 per hundred pounds, and $3.10 for pressed spikes.

Pile Foundations, etc.—In the Ohio Legislature on the 9th, a bill was introduced by Mr. Stevenson—authorizing Mansfield to borrow $10,000 to purchase a steam fire engine.

The following joint resolution was offered by Mr. Brown and referred to the Finance Committee:

Whereas, the General Assembly of Ohio, by an act passed on the 18th day of April, 1883, appropriated the sum of $200,000 to provide accommodations for insane persons not then or now furnished with State care, and appointed a commission to determine the manner in which such provision should be made, and to adopt plans therefor which might require the expenditure of a sum not to exceed $500,000;

Whereas, Under said act steps have been taken looking to the construction of an asylum for the insane in Lucas County which will require at least the full sum of $500,000; and

Whereas, It has been ascertained that quicksand in the ground at the site selected for said asylum will greatly enhance the cost of making foundations for the necessary buildings for said asylum, and may possibly endanger the security and permanence of said building; therefore,

Resolved by the General Assembly of the State of Ohio, That the Governor be and is hereby authorized and directed to appoint three skilled and competent builders who do not reside in the county of Lucas or its vicinity, and who, in his opinion, will make a thorough and impartial investigation and report, whose duty it shall be to visit the site of said asylum and make a careful examination thereof, and report to the Governor by the 10th of March, 1885, for the use of the General Assembly, upon the following points, with such recommendations as they may deem pertinent, to wit:

1. Whether it is necessary to resort to the use of piles at said site in order to secure a solid foundation for said building.

2. If piles are necessary for that purpose, what will be the probable additional cost, by reason of using the same, of constructing said buildings at said site; and,

3. How long, in the opinion of said commissioners, will piles used at said site remain sound and sufficient to make the foundations of said buildings solid and safe. Said commisioners shall have the same powers as to the summoning and examination of witnesses as are given by law to committees appointed by the General Assembly, and said commissioners shall each receive $5 per day and necessary expenses while engaged in the discharge of their duties under appointment of the Governor by virtue of this resolution.

Railroad Bridges and Canals.

The Kansas City, Topeka and Northwestern Railroad Company has been chartered. The incorporators are Jacob Safford, Topeka; A. C. Merritt, Louisville; A. Richards, West Moreland; J. C. S. Murphy, Irving; Jason Youran, Blue Rapids; W. W. Smith, Waterville; D. E. Ballard, Ballard's Falls; Wm. Kalhalfer, Hanover, and H. Charters, Hollenburg. The route of the proposed road is from Topeka westward through Counties of Shawnee, Wabaunsee, Potawattomie, Marshall and Washington to the State line between Kansas and Nebraska; the estimated length of the road to be 100 miles.

The Ottawa, St. Lawrence & Schenectaday railroad was incorporated last week, with a capital of $5,000,000. The road is to be constructed and operated from a point on the St. Lawrence, near Canton, where a bridge is to span the river, to Schenectady, passing through St. Lawrence, Hamilton and Saratoga counties.

The St. Joseph, Hanover and Southwestern Railroad has been chartered at Topeka, Kan., the proposed route being from Hanover, in Washington County, to Clay Center, Clay County, running through the counties of Washington and Clay. The estimated length of the proposed road is fifty miles. The principal offices are to be at Hanover. There are nine Directors for the first year, as follows: Winslow Judson, St. Joseph, Mo.; Henry R. Whartwig, St. Joseph, Mo.; J. B. Campbell, Clay Center; W. H. Knight, Kimes; J. W. Beach, Greenleaf; Wm. Kalhalfer, Hanover; C. S. Chapman, Hanover, and G. Schnable, Fancy Creek. The capital stock is $600,000.

Minnesota Bridges.—Bills were introduced in the Minnesota Legislature Feb. 7th to 12th, appropriating money or authorizing the issue of bonds as follows:

$300 to build a bridge across Red Lake Creek at St. Hilaire, Polk County.

$1,200 to build a bridge across the Pomme de Terre River in Grant County.

$1,000 for a bridge across the Zumbro River, Dodge County.

$300 for a bridge across Rose Creek in Mower County.

$800 for a bridge in Sibley County.

Authorizing Crookston to issue $5,000 bonds for a bridge across Red Lake River.

Authorizing Polk County county commissioners to locate a state road, and appropriating $10,000 for bridges on the same.

$500 to build a bridge in Jackson County.

$1,000 to build a road in Aitkin County.

$500 to build a bridge in Hubbard County.

$3,000 to build a bridge in Mille Lacs County.

A bill to bridge Clear Creek Redwood County.

Appropriating money for a bridge in Otter Tail County.

A bill authorizing a bridge across the Mississippi River at Aitkin.

Authorizing the commissioners of Anoka County to issue $6,000 bonds to protect the bridge between Anoka and Champlain. Passed.

Authorizing Winona to issue $10,000 to build a bridge across Lake Winona. Passed.

Authorizing Anoka County to issue $6,000 bonds for a bridge across the Mississippi River.

Another Canadian Pacific Scandal.—OTTAWA, ONT., Feb. 10th.—[St. Paul *Pioneer Press.*]—A scandal of no ordinary character is ventilated by several parties who have just returned from the Lake Superior section of the Canadian Pacific. When spring sets in, it is claimed, there will be no track at all. It is said the dump has been made of roots, snow, and moss, with a small sprinkling of earth over them to make an appearance of solid bank. Gangs of men have deliberately shoveled away snow from the sides of the right of way, and then cut out moss in large slices and used the squares as foundations of the dumps. As stumps have been taken out from the sides to enable men to get at the subsoil, these, too, have gone in, and by the time the earth was in fairly workable condition only a few barrow-loads were needed.

At times grades had not even the substance of stumps above it, but consisted wholly of snowy muck and moss, and in other cases, on high dumps, cart-loads of sand, mixed with snow, have been thrown over to make a railway. It will be morally impossible for any traffic to be safely conducted over many portions of the line in the spring.

In another place for twelve or fifteen sections, through a cut of three feet, directly this snow was removed men were working in the water, and yet no drain was made previous to making the grade and laying the iron. The wet, soft slush was just shoveled out, a bush bed was laid on the frozen surface, the next day ties and irons laid on the bush bed, and on this the great Canadian Pacific Road is constructed as far as it goes. Several accidents and loss of life have already happened.

The line is characterized as a wonderful and fearful production of bad grading and plentiful trestling, but when inspected, like all the rest of this line it will pass. Public money will be paid for the railway, and when the spring time comes where will it be? It will take, it is believed by the most competent judges, as many men next spring and summer to remake the road as it has taken to mismake it. Every day confirms the belief that the company never intends operating the line, but is rushing it through so as to obtain payment of the loan. Sub-contractors are unable to get the money worked for, and the company is said to be in a bad condition.

WINNIPEG, MAN., Feb. 12th—Grading on the Canadian Pacific railway was completed north to Lake Superior to-day. Rails will be laid in six weeks, thus completing the road from Montreal to the Columbia river valley in the Rockies. General Superintendent Egan characterizes the Ottawa dispatch to the *Pioneer Press* a tissue of falsehoods, and the author a notorious liar. He reports the construction the best in Canada.

Any Gauge. A bill has been introduced simultaneously in both houses of the Tennessee Legislature to authorize all railroads in the State to adopt any gauge they choose.

Fort Worth and Denver R. R.—It is now definitely settled that the Fort Worth and Denver Railroad will complete the extension to a point thirty or forty miles west of Wichita Falls, Texas within the next 90 days.

The International Ry.—The Maine legislature has finally given the International Railway authority to cross Moosehead lake with its proposed air line from Montreal to St. John. The condition of the grant is the construction of a branch southward along the west shore of the lake to connect with the Bangor and Piscataquis.

Providence & Springfield R. R.—An amendment of the charter of the Providence & Springfield Railroad extending the time for construction to 1890, has been reported favorably by the Committee on Corporations of the Rhode Island legislature.

Canadian Pacific.—The grading connection of the Canadian Pacific around the north shore of Lake Superior was made on last Wednesday with the east. Rails are to be laid in six weeks. The point of connection is 700 miles west from Montreal.

The Northeastern Extension.—It is reported in Athens, Ga., that the Richmond and Danville syndicate will not extend the Northeastern road to Rabun Gap by next year, as their contract with the city demands. The council will investigate the matter, and insist on the agreement being carried out to the letter.

Improving a National Trail.—TOPEKA, KAN., February 12.—In the House, to-day, the Senate concurrent resolution asking Congress to build bridges and improve the trail from Caldwell, Kan., to Wichita Falls, Tex., the same being used as a military road for the transportation of supplies via Forts Sill and Reno, was concurred in.

The Chicago, Rock Island & Pacific will shortly begin work on an extension of its Winterset branch from Winterset, Ia., southward to a connection with the Southwestern Division. This extension will make a direct line from Des Moines to Kansas City.

N. Y., T. & M. R. R.—When Congress adjourns Congressman Tom Ochiltree will go into the Directory of the New York, Texas and Mexican Railway (Mackay's road). In a private letter Ochiltree says the construction of this line will be commenced on the section between Victoria and Goliad in July.

Cheek.—"When it comes to a question of nerve," says the New York *Dial*, "real good, four-ply, triple-X-cheek—put the Pacific Railroad Managers at the head. The latest instance is reported from Chicago to the effect that the Canada Pacific has proposed that the Government purchase back unsold lands at $2 an acre. This will enable the company to raise money on their stocks and bonds.

Manitoba Railway.—WINNIPEG, Jan., 31.—Notwithstanding that there have been at least thirty railway charters granted in Manitoba during the past ten years, it is a curious fact that of them all (outside, of course, of the Canadian Pacific railway and its branches) only one company has shown any evidence of vitality and enterprise.—Correspondence of *The Toronto Mail*.

Cashie and Roanoke R. R.—A bill has been introduced into the North Carolina Legislature incorporating the Cashie and Roanoke Railroad and Lumber Company, commencing at a point at or near Hill's Ferry, in Bertie county, and thence to a point in said county at or near Simmons' Landing, on the Cashie River.

Raleigh & Augusta R. R.—Here is a bit of railway news which is of special interest to Raleigh people. It is from the Pittsboro *Record*: "Mr. Womack has introduced into the Legislature a bill to authorize the Raleigh & Augusta air-line railroad company to build a branch road to Pittsboro. We understand that this company will lay the track and equip the road if our citizens will grade the road-bed.

The Suez Canal in 1884.—The returns of the tonnage on the Suez Canal in 1884 are just at hand, and show an increase over 1883 of about 100,000 tons, says *Bradstreet's*. The number of vessels passing through in 1884 was 3,284, measuring 5,875,434 tons, as compared with 3,307 vessels, measuring 5,776,426 tons in 1883. Of the total number of vessels going through the canal, Great Britain sent 2,473, or about two-thirds, and the number of tons was 4,469,246, or just 75 per cent. of the total. The number of American vessels going through the canal was four, thus exceeding two countries in the world, China and Denmark, which sent NO vessels through.

Effects of R. R. Depression.—A recent writer on economy shows that through the curtailment of railroad building between 1882 and 1884 more than 40,000 laborers were discharged and forced to seek employment in some other kind of work.

Improving Business.—President Milliard, of the Indianapolis Car Works, is in excellent humor, so favorable are the prospects for business. He is now working his wires, with good promise of securing the contract for 1,500 or more cars; in fact, all over the country indications are encouraging. The Baldwin Locomotive Works received a large locomotive order, and two or three contracts for cars were placed in the Pennsylvania Car Works last week.

Minn. & N. W. R. R.—So far as weather conditions permit work is progressing on the Minnesota and Northwestern Railroad. The work is graded 100 miles to Mona. It is expected the road will be completed in sixty days after the beginning of settled weather, and that the bridge between St. Paul and the West Side will be finished in June. One hundred flat-cars and four locomotives are ready now for delivery. Although the new road connects at Mona, Io., with the Illinois Central, the latter company has no investment in the Minnesota and Northwestern, and is entirely independent in its sphere.

The Canton & Waynesburg, O. Road.—The chief item of interest at present is the prospective early completion of the Canton & Waynesburg Railroad. Mr. Charles C. Cook of Canton, the Secretary, and others of the projectors were in Waynesburg this week, looking after right of way and other matter. Five miles of the grade near Canton was finished and some iron laid. An 800 foot tunnel is to be commenced at an early day, and when it is finished the rest of the work can be done in a few weeks, as the grades are very easy. Waynesburg will be the terminus of the road, at least for the present.

The Anniston and Northern.—We learned yesterday from the best of authority, that all of the arrangements to begin work on the Anniston and Northern Railroad had been completed. The Directors met in Louisville last Monday and ratified all the necessary contracts. The first mortgage bonds have been issued, signed and placed with the Fidelity Trust Company. They were all taken by the parties who advanced the money to build the road. Mr. Fawcett is now in Boston, and as soon as he can arrange some of the details work will begin—say in a couple of weeks. The steel rails have been purchased and the right of way through the whole of Etowah County secured. The road will be in running order by October.—*Anniston (Ga.) Hot Blast*.

Columbus and Atlanta.—It is extremely gratifying to us to hear the favorable comments upon our Sunday's editorial on the railroad situation as regards Columbus. Since this article appeared changes have occurred that make us more certain that the people of Columbus should take early and favorable action on this matter. The Spartanburg and Asheville railroad company, so the telegraph announces, has made an arrangement with Inman, Swann & Co., to secure an advance of $450,000. This insures the completion of that road to Asheville. The contract for the completion of the Sheffield (Alabama) road has been let and the road will go to the Tennessee river, and go quickly. These indications show that a return of confidence has come and that the south is the favorite action in railroad enterprises. They are most needed here, they promise most capital here, they are opening up larger fortunes here.—Columbus, Ga., *Enquirer*.

Market Report of Engineering Materials.

New York, February 18, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	2.3c. @	2.6c.
Tee	2.8c. @	3c.
Beams and channels	3.0c. @	3.5c.
Tank	2.2c. @	2.3c.
Shell	2¾c.	
Steel plates, Tank	3c. @	3¼c.
WROUGHT-IRON PIPE.. PITTSBURGH.		
Butt welded, black.....Discount	47½	
" " galvanized..... "	40	
Lap welded black..... "	65 @ 67½	
" Galvanized..... "	47½ @ 50	
Boiler tubes..... "	60	
RAILS.		
Steel (large lots at mill)	$27 @ 28	
Old rails	18.50 @ 19	
R. R. spikes		2c.
R. R. splice-plates	1.65c. @	1.75c.
R. R. Track Bolts	2¼c @	2½c.
Barb-wire fencing, galvanized		5c.
" " painted		4c.
Corrugated iron		
Nails.		
Iron	2.25	
Steel	2.35	

METALS.

COPPER.		
Lake Superior	11¼ @	.11⅝
Other Brands	10¾ @	11
LEAD.		
Com. Domestic	3.60 @	3.70
Lead Pipe	.05¾	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.06¾	
ZINC.		
Sheet	.05	5¼

BRICK.

(Cargoes afloat)		
Haverstraw 1st.....per M.	$6.00 @	6.25
" 2nd..... "	5.62 @	5.87
Fishkill	4.75 @	5.50
Up-River		
Jerseys	5.25 @	6.00
Long Island		
" pale		
FRONTS.		
Croton red	14.00 @	
" dark	14.00 @	
" brown	12.00 @	
Philadelphia pressed	22.50 @	23.00
Trenton "	22.50 @	23.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English	65.00 @	130.00
" American	85.00 @	120.00
Fire brick	25.00 @	40.00

CEMENT.

PORTLAND.		
Robins & Co., Extra English 425 lbs. per bbl.	2.75 @	2.90
K. B. & S. English 400 lbs	2.85 @	3.00
Burham " "	2.70 @	2.85
Rochester Castle " "	2.50 @	2.60
J. B. White & Bro. " "	2.50 @	2.60
Other brands, " "	2.40 @	2.50
Keene's fine " "	9.50 @	9.75
" course	5.25 @	5.50
Roman	2.75 @	3.50
Dyckerhoff, German 400 lbs	2.60 @	2.65
Star, " "	2.60 @	2.65
Alsen, " "	2.55 @	2.60
Hanover " "	2.40 @	2.50
Other brands, " "	2.35 @	2.40
Saylor's American	2.15 @	2.25
Rosendale cements	0.90 @	1.00

LIME.

Rockland common per bbl	1.00	
" finishing	1.20	
Glensfalls, common	.85	
" finishing	1.05 @	1.10
Kingston, ground	0.95	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90 @	95
" " No. 2 "	0.75 @	0.80
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " " "	0.75 @	1.00
Brownstone, Portland, Ct. "	1.00 @	1.30
" Belleville, N. J. "	0.75 @	1.25
Granite, rough	0.60 @	1.25
Common building stone per load	2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @	3.00

SLATE.

Purple roofing per square	6.00 @	7.00
Green "	6.00 @	7.00
Red "	15.00	
Black Penna. (at New York) "	4.50 @	5.00

LUMBER.

PINE, Common box per M.	18.00 @	20.00
" Good "	55.00 @	60.00
Tally plank, 1¼ in each.	.44 @	.50
Tally boards, dressed "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 2 in. dressed "	.43 @	.45
Timber per M.	20.00 @	22.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2½ × 4 to 4 × 6 in	.17 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00 @	40.00
YELLOW PINE, Girders "	26.00 @	35.00
Dressed flooring "	30.00 @	40.00
SHINGLES, Extra shaved pine, 18in. "		
" " sawed 18 in. "	4.50 @	5.00
LATH, Cargo rate "	2.50 @	2.60

PAINT.

Lead, white, American dry per lb.	.04¾ @	.05
" " in oil pure "	.05½ @	.05¾
English, B. B. in oil "	.08¾ @	.09¾
Red, American "	.05¾ @	.06½
Litharge "	.05 @	.05½
Venetian red, American "	.01 @	.01¾
Indian red "	.05 @	.10
Vermillion, American lead "	.11 @	.11¾
Paris green "	.15 @	.19
Umber, Amer. raw and powdered per lb.	.01¾ @	.01½
Drop black, Amer. "	.08 @	.12
" " "	.09 @	.11¾
Chrome green	.05 @	.15
Oxide zinc, American	.03¾ @	.04
" French	.06¼ @	.06½

A New Iowa Line.—Immediate steps are being taken to build a railroad from Rockwell City, in Calhoun County, to the western or northwestern line of the State. The company is incorporated with a capital of $1,500,000, and the road will be called the Calhoun, Sac & Dakota Railway Company. This road connects at Rockwell City with the Wabash extension from Des Moines, and it is designed to open up and develop the wheat region of Northwestern Iowa.